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From Way Back. THE longest horse car line in existence is said to be one running between two towns in Brazil, 50 miles apart. Coal, engineers, enterprise and electrical journals must be scarce down there.

Telephoning a Thousand Miles. A GREAT feat in telephoning and one which marks very important progress in this field was accomplished a few days ago when the new line between New York and Chicago was formally opened. This is not only the longest distance yet attempted, but it is twice as great as that of any other telephone line in use. Some idea of the magnitude of the undertaking is had from the fact that nearly a million pounds of copper wire are used in the line, and that the tariff is $9 for five minutes' conversation, which for say 20 hours a day represents an income of over $2,000 a day. It proved to work very successfully, even a whisper being distinctly audible. It may seem strange to many that telephoning over such a long line is so successful while that over the short city line is wretched and unsatisfactory. This is due largely to the fact that the best known apparatus is used and the greatest possible care taken, while in the city service cheap, old, antiquated apparatus is largely used, with a view to making as much money as possible regardless of the service, a natural result of a monopoly of a public necessity.

The Railway Convention. BY far the largest gathering of street railway men and representatives of the supply companies that has ever attended the annual convention of the American Street Railway Association was that in Cleveland last week. Not far from 600 delegates and others were registered at the various hotels, and either attended the sessions of the association or inspected the very creditable display of street railway apparatus made by the leading supply houses or parent companies. As a whole the convention may be regarded as a very successful one, although some of its features were rather disappointing. The discussions brought out by the papers presented were as a rule rather aimless, and as a consequence, the delegates were unable to gain much information of value regarding the experiences and failures of their colleagues in the street railway business. This is especially to be regretted in a representative gathering such as the Cleveland convention, since a knowledge of the failure or success of any method that had been tried in order to secure a more economical operation—and this is, other things being equal, the chief aim of a very enterprising railway manager—would contribute very largely to the rapid advance of the entire business, and aid street railway men in deciding whether to adopt or reject proposed methods of operation and management. Although the subjects of the papers presented were largely electrical and covered well the leading topics of interest to street railway men, there was a noticeable lack of discussion of these subjects, the more familiar ones of roadbed construction and the like receiving much more marked attention. It is probable, however, that much good work was done by the interchange of opinions as to apparatus and methods between the delegates when outside of the convention hall and beyond the reach of the stenographer's ears, and this is certainly one of the most important and profitable features of such gatherings. In the papers read, which we publish elsewhere, some interesting points were brought out. For instance, in a comparison of the earning power of electric with that of cable roads, Mr. Ramsey shows it to be as four to three, each dollar invested earning .020 of a cent per day on electric roads, and .015 of a cent on cable roads, while the investment in the latter is 2½ times that of the former. Mr. Bickford shows the importance of adding a machine shop to the equipment of an electric road. Mr. Moxham states that continuous rails can be used, thus doing away with the objectionable joints. Mr. Ostrom recommends a standard rail head, and Mr. Crosby with his committee continued their creditable work on railway standards. A very noticeable feature about the papers was, that nearly all of them were either on electric roads or dealt largely with them.

Progress in Electric Railways. THE recent progress made in the application of electric traction to street railways, and the comparison with its rivals, the horse and the cable, was very tersely stated by President John G. Holmes, of the American Street Railway Association, when he opened the meeting of the association at Cleveland, by saying: "This city offers a fine opportunity to study practical street railroading. Here we see the most advanced ideas of construction, the highest development of the electric system, and a splendid new cable plant, as near perfect as capital, invention and engineering skill have been able to make it. And by the way of contrast and historical interest, we find a few horse car lines to remind us of the meetings a decade ago, when we used to grow excited over discussions of the relative merits of the horse and the mule as a street railway motor. This is preeminently an electric age, and most of us believe that as yet we are only standing on the threshold. The horse and his half brother, the mule, are destined to disappear. The cable system, from its very nature and cost, must be confined to the thickly populated districts of large cities, but there seems to be no limitations to the electric railway. So accustomed have we become to rapid strides, and the complete overturning of the existing order of things in our business, that I do not believe that one among you would venture a doubtful smile were I to assert that before the close of the nineteenth century the three successive convention cities, Buffalo, Pittsburgh and Cleveland, will be joined together by a triangular electric belt line, with an immense power house at Niagara Falls, where they are even now just on the point of developing 160,000 h. p."

Cost of Electric vs. Steam Railroads. A RECENT engineering journal contains a letter from a well-known engineer, in which he gives some approximate figures on the cost of a steam locomotive as compared with that of an electric motor and the necessary generators of the same power. From these he finds that the latter would cost over eight times as much, and concludes from this as follows: "I feel confident that the above figures or any modification that may reasonably be expected will be a most serious obstacle to the utilization of electricity for steam railroad trains." Such a statement, coming from an authority so highly respected should not be left unanswered. It reminds one somewhat of statements made by some engineers prior to the introduction of steam navigation, to the effect that, according to their figures, such navigation would be impracticable, or even impossible. But notwithstanding these unfavorable predictions steam navigation is not only possible, but has replaced the old methods to a very great extent, even though there is an enormous difference in the first cost and the cost of operation and maintenance in favor of the sailing vessel. On canals alone the mule is still able to hold its own. We do not wish to infer that the difference between steam and electricity for traction is one of the same degree as that between wind and steam for navigation; it is merely a difference of the same kind. We recognize perfectly well the numerous difficulties encountered in replacing steam by electric traction, and we do not for a moment suppose the change to be made to-day or to-morrow, but it does not seem quite just in view of the very rapid development of electrical engineering to discourage in its infancy the fast extending field of electric traction, as the author referred to and one other well known electrician do. The former states that a 1,200-h. p. locomotive is necessary for high speed trains, that it costs about $10,000, and that a stationary engine, boiler and generator of 1,600 h. p. with a motor of 1,400 h. p. cost about $81,000; in addition to this there is the cost of the buildings and the line construction. Assuming for the moment that this estimate is correct, is that in itself a sufficient reason for discouraging electric railroading? Cable roads and electric street railways cost much more than horse roads, yet the latter are going out of use very fast. Notwithstanding that steamboats cost much more than sailing vessels, they have been and are still replacing the latter. A careful business man will always weigh the additional cost of an article with its advantages over cheaper articles; the cheapest is not necessarily always the best, especially not in engineering. The writer in question does not seem to consider the advantages. Some of these have been repeatedly discussed in our columns and it is not necessary to enumerate them again. Safety to human life due to the more perfect control of a block system ought alone to be worth something, although it is difficult to state its value in dollars and cents. In examining the figures which have been presented, they appear to us to be very much one-sided. For instance, he takes the very unfair and impractical case of a single express locomotive, or else assumes that the steam power must be equal to the sum of the maximum powers of all the locomotives running or idle. He does not consider the time during which the locomotive is out of service for cleaning or repairs. From a paper in our last issue it appears that an average of 200 to 300 miles a day is good service for a locomotive. It must therefore be at rest longer than it is in use. Neither does he consider the fact that the weight of the locomotive and its loaded tender is a very large part of the whole weight of the train to be moved; it appears from the paper already referred to that it takes one ton of locomotive to draw three to four tons of cars. Something, though perhaps not very much, should be credited to the greater efficiency of the stationary engine as compared to a locomotive engine. A true comparison of coal economy should take into account the actual coal consumption per month of a large, nearly uniformly loaded, stationary condensing engine, as compared with that of a number of smaller locomotive engines intermittently loaded, starting and stopping continually, each under the control of a separate engineer and fireman, who are beyond the control of a supervising engineer or of recording apparatus. The wages of so many firemen are also to be compared directly with the economy of coal. Then there is a probable reduction in the cost of bridge construction and the repairs of rails and roadbed, which for a light rotary motor would, doubtless, be considerably less than for a heavy reciprocating engine not balanced dynamically. Furthermore, rapid transit, in effect, besides better express and local service, can be obtained with single cars at frequent intervals, even though their speed is no greater than that of the present long trains of a number of cars at correspondingly long intervals. In this city horse cars compete favorably with the elevated roads running above them on the same streets. Although we must admit that electric railroading is not yet ready to replace steam railroading, yet we do not believe it wise or justifiable to discourage the development of such an important branch while in its infancy, in the face of such promising possibilities.

The Cleveland Convention of the American Street Railway Association.

The eleventh annual convention of the American Street Railway Association, which was held on Wednesday, Thursday and Friday of last week in Cleveland, O., was the largest and, in some respects, the most important convention of this kind that has ever been held by the association. A number of important reports and papers were presented by street railway men, and these were discussed at considerable length. In addition to this, the exhibition of street railway apparatus and appliances, which was made in connection with the meeting of the association, was a decided success, as it was the largest and most interesting collection of street railway appliances that has ever been brought together in this country.

The morning session on Wednesday was taken up with the address of welcome by the Mayor of Cleveland and the address of the president of the association, Mr. John G. Holmes. The reports of the treasurer and the executive committee were also presented, as was a short sketch of the organization of the street railway men, which afterward led to the formation of the American Street Railway Association, presented by Mr. D. F. Longstreet, of Denver. The report made on "A Model Electric Street Railway, Roadbed and Undergound Wiring," was also presented at this session by Mr. George W. Baumhoff, of St. Louis, but the discussion on this paper was postponed until the evening session. The afternoon of Wednesday was fully occupied by an excursion made in reply to an invitation to inspect the works of the Short Electric Railway Company and of the Brush-Swan Lamp Company. The party was taken in special cars furnished by the Short company, and a liberal lunch was provided for all who attended at the factory of the company. Souvenirs were distributed by both companies to the delegates.

At the evening session a long discussion took place upon Mr. Bickford's paper, consisting almost entirely of expressions of the views and experiences of a number of street railway men. Their views were as a rule so different regarding the best weight and height of rail and the construction of joints, that no very general conclusion can be drawn. With the exception of a few points every one agreed with the statements made in the paper.

A committee was appointed to consider the question of a permanent industrial institute for the exhibition of all inventions and supplies relating to the street railway business. This committee was as follows: H. C. Payne, Milwaukee, Wis.; D. F. Longstreet, Denver, Colo.; O. T. Crosby, Boston, Mass., and H. A. Everett, Cleveland, O.

The only paper presented at this session was on "A Perfect Overhead Electric Construction," which will be found elsewhere in our columns.

At the morning session of Thursday the first business taken up was the report of the committee on "Economy of Electric Street Railway Machine Shops," presented by Mr. J. H. Bickford, of Salem, Mass. A rather full abstract of this paper will be found elsewhere in this issue. In the discussion following this paper the suggestion of having a machine shop connected with every electric road was concurred in without exception; it was suggested, however, that unless care is taken these shops would grow too large and become a source of great expense. It was thought that to cut gears in such a shop was carrying the idea too far. Mr. Bickford's paper was followed by the report of the committee on the "Relative Cost of Operating Horse, Cable and Electric Roads." A full abstract of this report is given in our columns this week.

The report of the committee on standards was the first business of the evening session on Thursday. After the presentation of this report by Mr. O. T. Crosby and its discussion, President Holmes offered the following resolution, which was adopted:

Resolved, That it is the sense of this convention that the standard rating of railway motors shall be the horizontal pull which the motor can exert when running the car at 10 miles per hour with 33-inch wheels, and that when so running the temperature of the motor shall not be raised more than 65 degrees centigrade above surrounding atmosphere after a 10-hour run.

The committee on nominations reported the following names for officers of the association for the ensuing year:

President, D. F. Longstreet, Denver, Colo.

First vice-president, A. Everett, Cleveland, O.

Second vice-president, Joel Hurt, Atlanta, Ga.

Third vice-president, W. Worth Bean, St. Joseph, Mich.

Secretary and Treasurer, W. J. Richardson, Brooklyn, N. Y.

Executive Committee: John G. Holmes, Pittsburgh, Pa.; J. D. Crimmins, New York City; T. J. Minary, Louisville, Ky.; J. R. Chapman, Grand Rapids, Mich.; B. E. Charlton, Hamilton, Ont.

The secretary reported that the executive committee had considered the matter of the formation of a supply dealers' association in connection with the American Street Railway Association, and that in the judgment of the committee they could see no necessity for the formation of such an association at the present time. This question was taken up by the supply dealers themselves at a special meeting in the Hollenden House on Wednesday evening, and after some fruitless discussion they appointed a committee and adjourned to meet again on Thursday evening after this committee had conferred with the executive committee of the Street Railway Association.

On Friday morning two papers were presented by title; these were "Experiments on the Expansion of Continuous Rails," and "Is a Standard Rail Possible?"

The following resolution was presented and adopted:

Resolved, That the American Street Railway Association sends greeting to the Tramway managers and officers of European and foreign countries, and most cordially invites them to attend the twelfth annual meeting of this association to be held in Milwaukee, Wis., U. S. A., in 1893, during the World's Columbian Exposition.

Resolved, That the secretary take such measures as in his judgment may seem necessary to carry out the above.

A motion was carried to the effect that the secretary be authorized to express to the Short Electric Railway Company the appreciation of the courtesies shown by that company to the delegates in attendance at the meeting. The association then adjourned, to meet in Milwaukee, Wis., on the third Wednesday of October, 1893.

The Attitude of the General Electric Company Toward Other Lamp Manufacturers.

To the Editors of the Electrical World:

In your issue of Oct. 15, 1892, you quote me on page 240 as saying "It is likely that manufacturers in different sections of the United States will be licensed to make lamps on royalty." You surely misunderstood me, for I have been extremely careful to give no intimation whatever as to the policy of the company in this regard, for the very obvious reason that no policy has as yet been formulated.

As you state in the next paragraph, "The case of each manufacturer will probably be taken up separately," and we shall use every effort to aim, if possible, at an "amicable arrangement" of such a character as will be fair to the licensees under the Edison patent, and to our stockholders; but whether in any case our efforts in this direction will result in granting manufacturing licenses will depend upon the development of affairs, and it is impossible, at the present moment, to even foreshadow any definite policy.

Trusting that you will give this letter the same prominence in this week's issue that you gave to the statement above referred to, in last week's issue, I am,

Yours very truly, EUGENE GRIFFIN.
First Vice-President of the General Electric Co.

NEW YORK CITY, Oct. 18, 1892.

The New Westinghouse Lamp.

To the Editors of the Electrical World:

I have just noticed in one of the electrical periodicals a description of the "new Westinghouse lamp," in which it is said that: "The lamp is a separable one, that is, the filament can be removed and the bulb used over again. This is accomplished by attaching the burner to a ground glass stopper, etc."

Permit me to call your attention to an application filed by me Nov. 22, 1880, No. 20,978, from which I quote the following:

"My invention consists of an electric lamp which is made in two parts, of a lower part or support and of a separable bulb or globe, the contracted neck of which is accurately fitted to the supporting part by a ground joint, etc." The first claim of that application reads:

"An electric lamp consisting of a separate globe or bulb *A*, and a base part or support *B*, said parts being connected by a hermetically sealed and ground joint substantially as and for the purpose set forth." The specification describes at length that the "purpose set forth" is to use the globes over and over again. This application, remarkable as it seems, was rejected four times—on Dec. 10, 1880; Feb. 16, 1881, March 2 and March 31, 1881. Commissioner Marble said, on Dec. 10, 1880: "Broadly considered, a claim for a ground glass stopper in an electric lamp is not patentable." On March 2 Commissioner Marble said: "It is met by any ground stopper on a glass jar, samples of which can be found in any drug store." The Westinghouse company publishes that its new lamp is covered by patents of its own. As the description of its new lamp is identical with my rejected application I beg to point out that, if the ground glass stopper is a patentable feature in an incandescent lamp, which I never doubted, it belongs to me.

Yours, etc., L. K. BŒHM,

NEW BOOKS.

TELEGRAPH CONNECTIONS: Embracing Recent Methods in Quadruple Telegraphy. By Charles Thom and Willis H. Jones. New York: D. Van Nostrand Co. 1892. 59 pages, 20 plates. Price $1.50.

A recent writer in an English contemporary had a complaint in regard to the lack of good books on telegraphy, but we venture to say that he would have modified his remarks as far as the practical side of quadruple telegraphy is concerned had he seen the above work before writing. The aim has been to furnish a work of a practical character, embracing the latest advances in the art of quadruple telegraphy, and illustrated by working diagrams rather than by useless pictures of instruments.

The descriptions are plain and concise and cover the entire field in a thorough manner. The plates are particularly admirable, three colors being used to distinguish circuits where two or more are employed. This is a commendable practice, and the authors and publishers deserve the thanks of the electrical reading public for inaugurating it. We predict that this work will soon take its place as a standard, and unhesitatingly recommend it to those interested in the subject.

HANDBOOK OF TABLES FOR ELECTRICAL ENGINEERS. Trenton: John A. Roebling's Sons' Co., 1892. 119 pages. Price, $1.50.

This little book is made up principally of tables relating to the dimensions and resistance of copper wire. In addition there is a résumé of the elementary laws of electricity definitions of electrical terms, tables of areas, specific gravities of metals, weight of insulated iron wires, and several others. The body of the book is devoted to tables showing the resistance of circuits carrying a given number of ampères with a given loss of E. M. F., and tables giving the resistance of various sizes of wire at different lengths. A wiring chart of the usual type is included, and a section of the book is devoted to tables of lengths and strains in spans of wire and suspension cables.

The book is well printed and will be found to be a very convenient work of reference for the office.

The Long Distance Telephone Line Between New York and Chicago.

The opening of the long distance telephone line between New York and Chicago marks an important step in the history of telephony. Previous to its completion the limit of successful transmission was less than 500 miles. It has now been practically demonstrated that conversation can be carried on between points separated by a distance of over 1,000 miles with as much ease as between local offices. The telephone will undoubtedly prove a powerful rival of the telegraph and will come more and more into use for the transaction of business between distant points as business men become more familiar with its use and acquainted with its merits.

The line was formally opened on Tuesday, Oct. 18, by Mayor Grant, of New York, and Mayor Washburne, of Chicago. Ordinary conversation could be heard with great distinctness. "The Star Spangled Banner" was played into the transmitter at the Chicago end of the line, and could not only be easily heard through the ordinary receiver at the New York end, but when a large funnel shaped receiver was connected, the notes were audible to persons standing some distance away. An interesting incident was the conversation of Prof. Alexander Graham Bell with William H. Hubbard, who assisted Prof. Bell in the installation of the first telephone line ever erected, at the Centennial Exposition in 1876.

The line extends from the main office of the American Telephone and Telegraph Company, No. 18 Cortlandt street, New York City, through New Jersey, Pennsylvania, Ohio and Indiana, and terminates at the main office of the company on Quincy street, in the city of Chicago, passing through Newark, Harrisburg, Pittsburgh and other cities, with branch lines to Cleveland and Toledo. In the Eastern States connecting lines reach all the important points from Portland, Me., in the east to Buffalo at the north, and to Philadelphia, Baltimore and Washington to the south. In the West branch lines are practically completed from Chicago to Milwaukee, and from Toledo to Detroit, and soon all important points in Ohio, Indiana, Illinois, Michigan and Wisconsin will be reached.

The length of the line is approximately 950 miles, and it has been constructed with great care. A double metallic circuit of No. 8 hard drawn copper wire is used throughout. This wire weighs 435 pounds per mile, so that the total weight of the circuit is 826,500 pounds. An ordinary telephone circuit of that length would weigh less than 200,000 pounds. The two wires forming the circuit are run on what is called the balance principle, that is the wire from New York passes on the north side for a short distance, then crosses to the south side, then back to the north side again, and so on. The use of cables has been avoided as far as possible, and they are employed only at the terminals and at the river crossings in the immediate vicinity of New York. The poles are of cedar and chestnut, 35 feet and upward in length, and average about 45 in number per mile, making the total number of poles 42,750. The transmitting instrument is the ordinary long distance telephone, with which the public is already familiar. The rate decided upon is $9 for five minutes' conversation, and while this may seem rather high, business men will probably find that the use of the telephone at this rate is fully as satisfactory as communication by telegraph.

A Large Swiss Slow Speed Dynamo.

The last number of "Industries" contains an illustration and description of the large slow speed dynamos which are in course of construction, designed by Mr. C. E. L. Brown, late of the Oerlikon company, in Switzerland, for the lighting station at Rouen.

The machines are intended for 120 volts and 1,200 amperes, at 320 revolutions, but are capable of giving 1,500 amperes and 180 volts, when used for charging accumulators. The armatures are drum wound with copper bars in parallel. The designer, Mr. Brown, claims that trouble does not arise from parallel winding if the bearings are well designed and kept in good order. They are large four-pole machines with radial magnets and external yoke piece, similar to the well known large Oerlikon machines, or like the one recently built by the

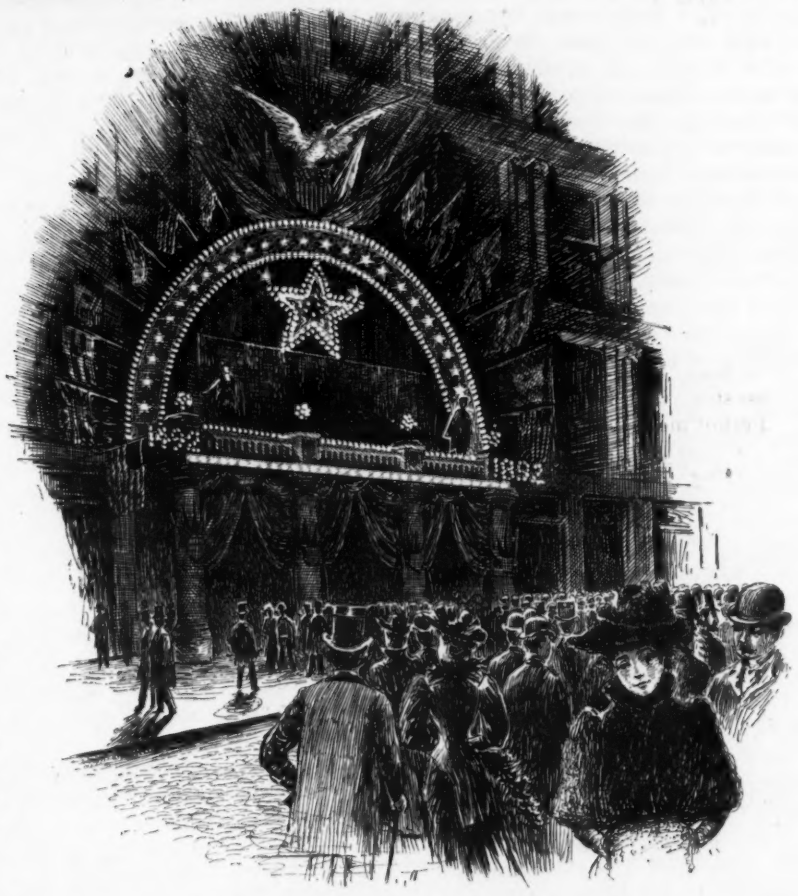
Thomson-Houston company. The armature sections are cross connected by curved plates, like those used in making the connection proper, thus permitting the use of two sets of brushes only. The armature cores are 31½ inches in diameter and 18 inches long, with only eight driving teeth of vulcanized fibre. The fields are of cast steel with steel pole pieces. The field coils are round, which Mr. Brown claims is a matter of considerable importance in the ease of manufacture. There are three bearings. They weigh about 10 tons each, and contain about 2,000 pounds of copper. When run as motors without a load the armature takes less than two per cent. of the full load, showing a very high efficiency.

Electrical Illumination During the Dedication of the World's Fair Buildings at Chicago.

To electricity is due a large share of the credit for the brilliant decorations which ornamented the streets and

buildings of Chicago during the dedicatory exercises on the Exposition grounds. The city presented a most attractive appearance by day, but the best effects were produced at night, when the streets and many of the more prominent buildings fairly blazed with light.

One of the most striking displays was that at the store of Siegel, Cooper & Co., which is shown in the accompanying illustration. The principal feature was the pillared arch of the main entrance, which rose to the top of the third story with a span of 50 feet. Four pillars 25 feet high supported a balcony on which stood figures of Columbus and Columbia upon pedestals, upon which were the dates 1492 and 1892, respectively, formed of incandescent lights. Forty-four silver stars, each centred with an incandescent light, were supported on the arch, which was fringed with electric lights. A large five-pointed star, 16½ feet across and set with 400 electric lamps hung from the centre of the arch. Other buildings which were brilliantly decorated were those of the American Express Company, the Great Northern Hotel, Alexander H. Revell & Co., Mandell Brothers and Marshall Field and McVicker's Theatre.



THE DISPLAY ON THE FRONT OF SIEGEL, COOPER & CO.'S STORE

The Resistance of Railway Curves.

Very little was really known as to the effect of a curve in increasing the resistance until the French government organized a series of experiments in this line in November of 1890. Although these experiments are not yet completed, some of the more important results are given in an article in the last issue of the *Bulletin de la Commission Internationale du Congress des Chemins de Fers.*

The problem is not an easy one, as the results are much affected by atmospheric conditions. In one case, for instance, the resistance of the same train running over the same piece of line and in the same direction was doubled after an hour's interval. Fog also makes a great difference with the ease with which a train rounds a curve, as it lubricates the rails, while wind is particularly injurious. The effect of greasing the rail or wheel flanges was studied, and it was found to decrease the resistance in a marked degree. Various forms of tires were also tried, and it was found that cylindrical tires and those coned to 1 in 20, as usual, gave equal resistances, but increasing the coning to 1 in 10 reduced the resistance materially, although these experiments were confined to the series in which there were no super-elevation of the outer rail. The tires shaped to correspond with badly worn tires showed a great increase in the resistance. When the usual circular fillet between the flange and the wheel was replaced by a conical surface the passage of the wheels around the curves was considerably facilitated, the resistance due to the curve being only about two-thirds of what it was with the normal form. Bogie carriages were not found to have a less specific resistance in passing around curves than cars of the ordinary type, but rather greater. The two trucks appear to act as two separate cars with very short wheel bases, which is unfavorable to the movement of the car, as the tendency to jam increases with the shortness of the base.

The conclusion is deduced from these experiments that the resistance is constant for all speeds up to 19 miles an hour in curves of 656-foot radius, and up to 25 miles an hour in curves of 320-foot radius. Above these limits the resistance increases proportionately to the speed. This, however, applies only in cases where there is no super-elevation.

The resistance of all kinds of vehicles, as well as of locomotives of different types, in curves of 328-foot radius is, on an average, about 18 pounds a ton. This figure may be reduced to 11 pounds or 14 pounds a ton without the use of complicated devices. In curves of 245-foot radius the average resistance does not exceed 22½ pounds per ton.

Library and Laboratory.

BY PROF. C. WELLMAN PARKS.

Prof. Thomas in his remarks made at the last meeting of the American Association for the Advancement of Science has, I believe, touched upon one feature of educational work that receives less attention in the United States than in any European country, and much less than it should receive from those who aim to make their institutions most efficient in training young men and women to become leaders in thought and action. I refer to the library, and one reason that can be given for this lack of attention is, that in choosing a college the availability and worth of its library is rarely taken into consideration, the questions that present themselves to be answered by the student and his parents being:

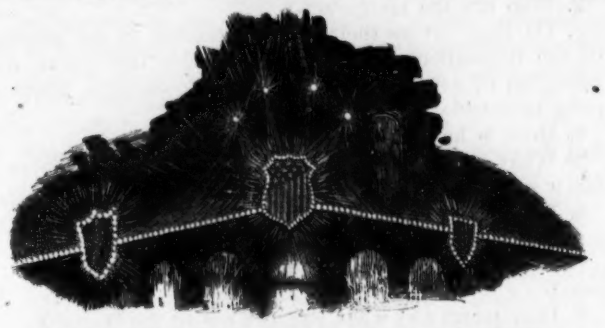
1. What will it cost?
2. What laboratories are there?

The first question is usually answered very imperfectly because the value of the instruction given is not often compared with the cost in money and time. Wherever this question is given undue weight it decides the sending of boys to institutions that can afford to provide neither high grade instructors nor first class equipment. The second question is asked by those who wish to do the best of work and have the mistaken idea that the laboratory is the royal road to knowledge.

If the laboratories are properly administered they are of the greatest value, but laboratories that are open only a few hours a year, or that are provided with too few experienced instructors, are not of as much value to the student as are smaller and better managed ones. Many educators appreciate the effect upon candidates for admission of laboratories and collections of showy apparatus, so provide these when they are not able to employ the proper number of experienced instructors.

For six years I tried to manage the department of physics in one of our oldest institutions and can say from actual experience that I consider seventy-five students a day more than can be properly intsructed without the aid of at least one assistant.

More important, however, than laboratories, and of as much importance as good instructors, are libraries, yet

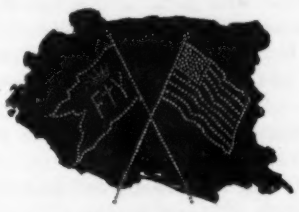


ENTRANCE TO THE CHICAGO TRIBUNE BUILDING.

they are rarely mentioned, and little used outside a few of our best colleges and universities. The number of volumes in a college library is a very slight indication of its value. The questions to be asked are: "Do students have proper access to the collection?" and "Are the books classified?"

Probably many books are bound volumes of periodicals—the richest and at the same time the least accessible sources of information. They are the richest sources of information because nearly every new idea is first expressed in a periodical. Later the novel idea may be buried in a mountain of words and ideas quoted from other sources and published as a book. Is not the first article better than the book? They are the least available sources of information on account of the difficulty of hunting out the article desired.

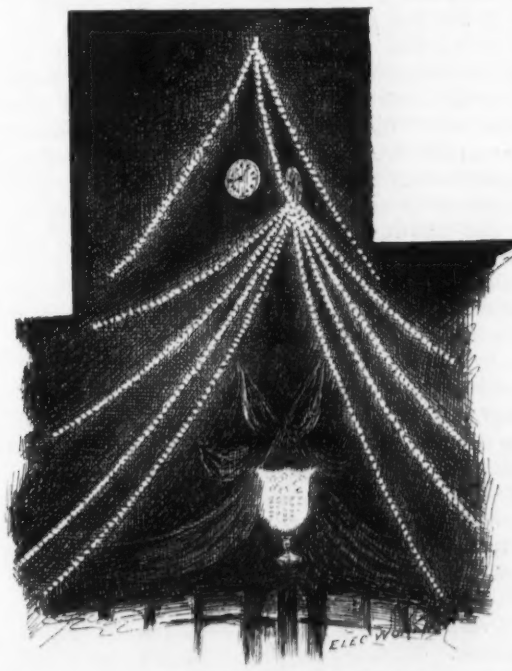
Various schemes of indexing these articles have been proposed and tried for a time, but have not been entirely



UNITED STATES AND SPANISH FLAGS ON THE FRONT OF THE AUDITORIUM.

satisfactory. For engineering periodicals Prof. Johnson has furnished a valuable monthly index, and for literary periodicals the "Co-operative Index" satisfies the demands made upon it. All who have used these indexes can certify to their being valuable aids. Plans are now being matured for the production of an index that will fill in the gap between the indexes named, and that may introduce some features that have not been found in any of the earlier indexes.

Whether the library consists of bound volumes of periodicals or of other books it cannot be made of very



THE INTER-OCEAN BUILDING.

great value without a card catalogue. Of course, when the library is all secured at one time a printed catalogue can be used, such for instance as one that I know that was printed about 1870, and is as good to-day as when first printed. It might be interesting to know that less than 70 of the 4,000 volumes in that library were taken out in any one of the last five years, and that it was open less than six hours a week.

In connection with the United States Bureau of Education and the American Library Association I am at work on a plan to arouse such institutions and cause them to take hold of their libraries and handle them for the benefit of their students. This plan contemplates the exhibition at Chicago of a collection of 5,000 of the best books on all subjects that are to compose a model library. These books are to be classified and catalogued and the catalogue is to be widely distributed.

In conclusion I would say that the following questions

should all be satisfactorily answered before a parent can feel sure that his son or daughter can spend advantageously a period of three or four years in any college or scientific school:

1. What is the ratio of actual instructors to students? (This should not be less than 1-10).
2. Who are the instructors?
3. Do they devote their whole attention to the needs of the institution, or do they give the institution a minimum of attention and devote their energies principally to outside work?
4. How is instruction given?
5. What laboratories are there, and how many hours can a student spend in each?
6. How many students work in each laboratory under a single instructor?
7. Are all the assistants graduates of the previous year?
8. How many and what volumes are in the library?
9. How many and what volumes were added to the library during the past year?
10. Is there a good card catalogue of the library?
11. Is the library accessible?
12. How much will it cost to follow the course of instruction?

The Future Ohm.*

BY CH. ED. GUILLAUME.

It is well known that the English propose to abandon the old British Association unit and, passing over the legal ohm, to adopt the 106.3 ohm. I intend here to examine into the reason of this form and to show its practical bearing.

As far back as 1884 many electricians, Lord Rayleigh and M. Mascart among others, demanded the adoption of the 106.3 ohm; but the few very low values obtained by physicists of reputation caused the mean 106 to be adopted, which satisfied no one, each one claiming that his own figure was right. As early as 1885 Prof. Rowland, whose determination, made with great care, supported the value of 106.3, proposed in a circular to reconsider the decisions of the Congress; but the public was tired of discussion and considered that the reform was premature. Moreover, Prof. Rowland's method of argument was not absolutely convincing, for attributing the co-efficient 6 to the high values and co-efficients as low as 0 to the low values, he could not help finding as a mean the number which he proposed as the result of his calculations.

However, new results were not slow in furnishing decisive arguments in the controversy. M. Kahlrausch and M. Dorn, who had found, respectively, the values of 105.51 and 105.46, went over into the opposite camp with the numbers 106.3 and 106.24. The figure of M. Wild, corrected for an error in the construction of a resistance box, was raised from 105.68 to 106.18, the lowest number of which still remained in uncertainty. Finally an excellent measurement by M. Wüilleumeier gave the result 105.27. This last observer had employed the formula of Messrs. Mascart, Nerville and Benfot for the reduction to 0° of the mercury unit of which he made use. The determination which I recently made of the variation of the resistance of mercury raises that number a little and brings it to 106.29. I will not go into details too much, but it is sufficient to say that the mean of the determinations worthy of consideration is almost exactly 106.3, with individual variations which do not attain a value of a half unit from the fourth figure. The exact mean is accurate to within less than two units of the fifth figure; in other words, it is extremely probable that the true ohm is comprised between 106.28 and 106.32, and it is not reasonable to suppose that that number will be fixed exactly for some years. However, the first point established in adopting the 106.3 ohm is that we do not work under an uncertainty. The commercial ohm will have that value of the true ohm which will remain the most probable value for some time to come.

The objection may be raised that the partial adoption of the new ohm will not suppress any of the old ones and will only add to the confusion. An examination of the facts leads to the opposite conclusion. The legal ohm, I have said, satisfies no one, and the discontent has manifested itself by matters being left in *statu quo*. Germany is today using the Siemens unit, England has preserved the British Association unit, which it is about to definitely abandon, and France, the country which is most open to reform, is divided between the legal ohm and the British Association unit. Germany shows herself disposed to adhere to the proposition of the British Association. I am informed, however, that that decision was not reached without a lively discussion between M. von Helmholtz and M. von Siemens. Nevertheless the step was taken. The value definitely adopted, yielding, as it does, to the wishes of French physicists, cannot but be well received here, especially as it will bring to an end a difference which has existed between the various State departments. In any case the Siemens and British Association units have had their day, and the new ohm can be considered as identical with the true ohm, the only competitor being the legal ohm of 1884. If this is abandoned, as I hope it will be, the system will be at last uniform. It is very probable, moreover, that the resistance boxes have gone ahead of this step, and that the coils constructed a few years ago according to the legal ohm have reached if not passed the true ohm.

*From *L'Industrie Electrique*.

The definition proposed by the British Association may be uncouth; it would seem in fact as if the adoption of an experimental length (106.3) could only be assigned by the *a priori* definition of a cross section which could be expressed by a whole number, the square millimetre. Yet to-day we have that cross section expressed by a number of six significant figures (14.4521 grammes of mercury in the tube). This last definition has been given for metrologists. In fact the elementary definition is the square millimetre, but with the specification that it is obtained by mercury weighings, taking as unity the value of the density of water, and 13.5956 as that of mercury. The metrologic definition would have been as accurate and certainly more clear if in place of indicating the total mass of mercury contained in 106.3 centimetres it had been defined as weighing 13.5956 grammes per metre.

I may add the remark that M. Barus has shown that the specific resistance of mercury diminishes by .0003 of its value when the pressure to which it is subjected is increased by one atmosphere. It would be proper then to add to the original definition the words "under normal atmospheric pressure," which is also for the use of metrologists.

With the adoption of an international ohm will end all of those differences so predjudicial to progress, because it causes time to be lost in the fastidious work of determination which might be employed for the advancement of true science. The unification of measures has made such great advancement during the past 20 or 30 years that one can hope that in a few years it will be possible to understand one another's writings without constant reference to a table of conversions.

Electrical Progress in Germany.

(From Our Special Correspondent.)

A project is on foot for an electric elevated railway in Berlin, and the negotiations between the authorities and Messrs. Siemens & Halske, who will carry out the work, have been concluded. The line is to run between the Warschauer Brucke and the zoological gardens. On the basis of this understanding, Messrs. Siemens & Halske applied some months ago for permission to construct the line; they will limit themselves, however, for the present, in view of certain practical considerations, to the section between the Warschauer Brucke and Nollendorf Platz, in the West End. The work will be commenced as soon as the concession is granted.

From some figures of the city gas works it would appear that the electric light is still a luxury in Berlin. The case in point is the lighting of the City Hospital, am Urban. The expenses connected with the electric light amounted, together with interest on the capital invested on the plant and amortization, to $10,820 per annum. If current had been taken from the central station, the figure would have been $17,064; while gas would have cost only $6,296. The difference of 30 per cent. between the cost of the electric light when produced by a private plant and when the current is taken from the central station is noteworthy.

The electric line at Bremen, installed on the Thomson-Houston overhead system, has been operating very successfully. The traffic on the Stadthaus-Horn section of the line has increased by 30 per cent. since it was opened on the 1st of May last. Five motor cars, with or without trailer, usually handle the traffic; but this has to be increased on Sundays to seven motor cars, with a similar number of tow cars. The tow cars each seat 40 passengers, and a train consisting of one motor car and one trailer is capable of carrying 80 or 90 passengers. In view of the increased traffic, the directors of the Bremen tramways have decided to change the existing schedule running of 17 minutes to 7½ minutes; and they have at the same time placed an order for 15 additional motor cars. The best evidence, however, of the entire satisfaction of the Bremen Tramway Company with the electric traction lies in the fact that they have ordered the electric equipment of the other parts of their line, viz., Bourse-Freihafen and Langenstrasse-Hohethor, so that these sections will also be ready for traffic by the end of the year. The entire tramway system in Bremen will then be worked by electricity.

The report on the Cassel station for the first nine months of its operation, viz., from July 1, 1891, to March 31, 1892, that being the end of the fiscal year, has just been issued, and is altogether exceedingly satisfactory. At the time of the opening of the station only 80 house installations were on the circuits; on March 31 last, 180 arc lights and 2,609 incandescent lamps were connected to the system. These figures have considerably increased up to date, and current is also being supplied now for motor work. The receipts, which were estimated at $13,035, amounted to $16,645, making $3,610 above the estimate. The estimate of the expenditure has only been very slightly exceeded; the expenses amounted to $12,180, leaving a total balance, therefore, of $4,465. This sum will not only meet the interest on the cost of installation and amortization, but will also provide a considerable net profit. Of this sum $1,190 have been appropriated to the city finances, and $3,275 have been placed to the reserve fund. When it is taken into account that the first year's running of a station is almost always attended more or less with some unforeseen expenses, and that, on the other hand, the receipts during the first few months are never very great, the results of these first nine months' running of the Cassel central station are to be regarded as particularly satisfactory. It may safely be assumed that still better results will be forthcoming in the future; that is to say, so soon as the public avail themselves to a greater extent of the advantages offered. The price of the electric light has already been materially reduced. A rebate was allowed regular customers during the first nine months on their paid accounts, and further concessions are to follow. It may be remarked that no interruption of any importance has taken place as yet in the working of the station; and everything, in regard to the system adopted, the execution of the work, and the organization of the running, has proved highly creditable to all concerned. The Mayor took the opportunity at the last public meeting of burgesses to advert to these facts, remarking that they sufficiently disposed of the attacks that had so generally been made upon the Cassel Central Station, stigmatizing it as a failure; and as to the personal and acrimonious criticisms that had been passed on the engineer, Herr Oscar von Miller, and the manager of the station, Herr von Noel, he was glad to be able thus publicly to tender the thanks of the city to these gentlemen for the way in which they had done their work. Finally, it may be mentioned that the city has voted something like $2,380 for the purpose of establishing a stock of installation material, in order to meet with promptness any demands that may be made upon the works in extension of the system. Hitherto each individual requisition involved the sending out of a special order, and, of course, the delivery always meant more or less loss of time.

The question of introducing the electric light at Leipzig is under discussion. It is in its first stage; that is to say, the Town Council has begun to think about it; but town councils never think quickly in Germany, so that it is not very likely that anything definite will be decided for a year or two.

The construction work of the electric road at Remscheid was commenced on Sept. 12. The whole installation is expected to be ready for running by about the middle of next year. The work will, of course, give employment to a large number of men, and this is particularly welcomed in view of the late depression in the local trade having rendered many hands idle. Remscheid is an important centre of the steel and iron industries.

The question of the electric lighting of Frankfort-on-Main is getting quite celebrated. The following is a brief resume of affairs there: In the first place it had to be decided whether continuous current or alternating current should be employed, and, again, whether single phase or multiphase currents. In order to solve this problem, the experts, Herr Lindley and Herr Oscar von Miller, were instructed to prepare a report on the subject. A very exhaustive report was accordingly drawn up by these gentlemen, and it embraced three different schemes which they had worked out; these were: 1, alternating current with transformers; 2, continuous current, with sub-stations in which the accumulators were to be charged direct; 3, continuous current with substations in which the accumulators were to be charged by means of alternating-continuous current transformers. The projects were based on an estimated maximum capacity of 67,000 16-c. p. lamps burning simultaneously, or their equivalent in arc lights or motors. It was ultimately decided that the alternating current transformer system of distribution would be the most favorable for Frankfort, having regard to all the local conditions. This report was submitted to the special commission which had been appointed to consider the electric lighting question, and the result of its deliberations was that the building of a municipal central station was recommended. The rate for current supplied was to be one cent per lamp hour, and large consumers were to be allowed a rebate of 30 per cent. Later on, when the works had been sufficiently extended, it was thought that this rate might be reduced to half a cent per lamp hour. Objections were in the meantime raised in regard to the experts' report, by the Hagen Accumulator Works and Schuckert & Co., and they are said to have even handed in counter proposals. It is not necessary to go into the details of these objections here; suffice it to say, that at the next meeting of the special commission Messrs. Lindley and Von Miller dealt successfully with the arguments brought against their report. The commission ultimately decided to submit their propositions to the Town Council in a somewhat modified form; they recommended the adoption of the alternating current system, but proposed that tenders for continuous current should also be considered. The report of the special commission was presented to the Town Council on Sept. 6th. It appears quite possible, in view of the developments above narrated, that the question of the electric lighting of Frankfort will not be decided again this year. The action of the Hagen Accumulator Works and Schuckert & Co. has been somewhat severely criticised. Their urgent representations have, at least, had the effect of securing the consideration of tenders for the continuous current schemes.

BERLIN, Oct. 15, 1892.

A Perfect Overhead Electric Construction.*

BY CHARLES H. SMITH.

The president has appointed me a committee on "A Perfect Overhead Electric Construction." In thus selecting me to prepare a paper on this subject, he evidently intended to pay a passing compliment to my imaginative or inventive powers. He asks me to describe something that does not exist, something that I have never seen, although I have searched diligently for it. I can, therefore, give only my ideas of how an electric overhead line should be constructed, based upon facts and information derived from personal experience and observation.

Iron or steel poles have proved to be the most desirable. I would therefore recommend the following: the poles to be of tubular iron 32 feet in length, and made in three sections, in the usual way. The lower section should be at least 7 inches in diameter, and the other two sections 6 inches, and 5 inches, respectively. The poles should be set in concrete, and at least 6 feet in the ground, and should not be more than 125 feet apart. The top of the pole should have about two per cent. of rake away from the curb, and should be fitted with a suitable pole clamp, so that the span wire can be easily adjusted to the required height, which should be 22 feet above the track. On top of the pole should be a malleable iron cross arm to carry the feeder wires, and guard wire spans. This cross arm should be insulated from the pole by means of a wooden plug inserted in the top of the pole. The insertion of the joints of the pole should be at least 18 inches, and the joints should be made solid throughout their entire length by means of shims or other contrivances. If these joints are not properly made, the poles will not stand the strain. For curves, or extra strain, there should be larger poles of the same make.

Span wires should be of No. 4 B. W. G. silicon bronze wire, and should be fastened to pole clamps by means of insulated turn buckles. Great care should be taken in insulating these turn buckles from the poles.

All well-built lines should be sectional, and the trolley wire should not be of too great a size, as it would then call for clumsy supports. As it is not the main current wire it can be of a smaller size. I would therefore recommend No. 4 B. W. G. silicon bronze wire, which affords sufficient carrying capacity and has great strength and durability.

Sections should not be of a greater length than two miles, and should be separated by trolley breakers, of which there are now a number of good ones in the market. In cities and villages where there is great liability of fires it would be advisable to put trolley breakers at shorter intervals. Trolley wire hangers and pull-off brackets should be of the lightest make possible, and still have the required strength and the very best insulation. There is a variety of such hangers and brackets now in the market.

As it is important to have as small a number of joints as possible in the trolley wire, it should be put up in mile lengths, and twisted splice joints should be made and brass cone shaped tubes slipped over the wire before the splice is made. After completing the splice, the larger ends of the tubes should be brought together over the splice and a little solder dropped through a small hole made in the tubes for that purpose, in order to keep the joint in place.

Overhead switches, or switch pans, should be avoided, if possible, as they become a source of great annoyance. I would strongly recommend a double trolley wire for a single track road.

Great care should be taken in erecting the guard wire spans. They should be properly insulated from the cross arm by means of a strain insulator, or something equally as good, and should be of at least No. 6 best galvanized iron wire. There should be two guard wires over each trolley wire at least three feet apart and four feet above the trolley wire. The guard wire must be well insulated from the guard spans; in case of other wires falling, this would be of great importance. Pull-off and anchor guy wires, or other wires for the same purpose, must be of the very best material, and of at least No. 8 galvanized iron wire.

Feed in taps must not be more than five poles apart and should take the place of the trolley span wire at that point. They should be of at least No. 0 insulated wire.

The trolley wire being sectional, it is necessary to run a feeder wire to each section. I would, therefore, recommend that the feeder wire be at least 30 per cent. larger than the occasion demands. It will be found that this is money well invested. The insulation on the feeder wire should be the best that can be procured, and I would advise using locust or iron pins with mica insulators or something equally as good, for the purpose of fastening the feeder wire to each pole, and great care must be taken to protect it from trees and other obstructions.

A cut-out box should be located on the pole at each trolley breaker, and should not carry a fuse. It should have the same wire running through it as there is on the outside. The fuses should be at the station, with ampère meter and cut-out switch for each section; then, in case of trouble on any section, the location can be easily seen, and that section cut out, if necessary, until repaired.

Lightning arresters are of great importance on the line, and I would strongly recommend using them at least every thousand feet. They can easily be attached to the poles, and can be protected by means of a box.

In conclusion, I would say that no matter what expense is incurred for material, or care used in constructing, a good line cannot be insured without a thorough daily inspection.

It is to be hoped that in the near future a perfect overhead electric construction will be realized in some of our large cities, for the example or fact will be of much more value and interest than any paper on the subject.

*Report of a committee of the American Street Railway Association, read at their Cleveland meeting.

Is a Standard Rail Head Possible?*

BY JOHN F. OSTROM.

[In the first part of the paper the author points out the need of such a standard and states that with the object of getting the opinions of others on the subject he wrote to car builders, and truck and wheel manufacturers, from 22 of which he received replies; also to every street railway company in the United States and Canada, from 306 of which he received replies. The majority of the former agree on a 2½ inch tread and a ¾-inch flange; a number of the others substituted a 2-inch tread. All the roads seem to agree on the general sentiment that "tram rails are no account for anything or anywhere." Many of the roads seem to be strongly in favor of T rails. Eighty-eight companies, operating 1,083 miles of track, suggest T rail; 60 companies, operating 1,101 miles of track, suggest girder rail; 45 companies, operating 1,243 miles of track suggest a section of girder rail deep enough to be spiked direct to tie in paved streets.]

The adoption of one width for rail head and one depth for flange room would, in my judgment, be the nearest approach that can be made to a standard rail. The necessity for a standard recognized, is it possible to devise one that can be accepted as such? In response to inquiries I received replies from 306 roads, operating cars on 4,347.8 miles of track. Twenty of these roads operate with steam motors over 155 miles of track; 29 with cable motors, over 328 miles; 99 with horses, over 1,117 miles; 198 with electricity, over 2,748 miles; 59 have 625 miles of springer rail track; 197 have 1,532 miles of T rail track; 146 have 2,190 miles of girder track.

I think you will agree with me that this mileage will justify us in assuming that the above reports may be reasonably taken to represent the condition of the street railway situation of the country to-day.

Two hundred and sixty-four roads reported width of wheel tread on 3,937 miles of track. These varied from 1½ inch to 5 inches, in 14 different widths, 2 inches, 2¼ inches and 2½ inches being used in the majority of cases; 170 roads, operating 2,942 miles, use 2¼ inches wheel tread or less; 56 roads, operating 568 miles, use 2½ inches tread. If these could be combined, and a 2¼ inch tread wheel substituted, we would have 226 roads, operating 3,510 miles, using one tread wheel, or about 84 per cent. of the reported trackage.

Two hundred and seventy-nine roads, operating 4,118 miles, reported 12 different depths of wheel flanges, varying from seven-sixteenths of an inch to 1½ inches, five-eighths and three-quarters inch being most largely used; 223 roads use three-quarters inch flange or less on 3,581 miles of road; 26 roads use a seven-eighths inch flange on 298 miles of road. If these could be combined, and a three-quarter inch wheel flange adopted, we would have 249 roads using this wheel flange on 3,879 miles of track, or 94 per cent. of the reported trackage. The adoption of such a wheel flange will be perfectly safe wherever the radius of curve at gauge line of rail is not over one-quarter inch.

Leaving the general results, let us look for a moment at the statistics of the 198 electric roads, with their sometimes dangerously high speeds, and their 2,748 miles of track; 181 of them reported 31 different wheels, varying from 1¾ inch tread and five-eighths inch flange to 3½ inch tread and 1½ inch flange on 2,640 miles of track; 109 of these roads use a wheel tread 2¼ inches, or narrower, on 1,870 miles of track; 51 companies use 2½ inch tread on 512 miles of track. If it were possible, as I believe it is, to combine these, we would have 160 companies using 2¼ inch tread on 2,382 miles, or 90 per cent. of the electric mileage reported.

One hundred and forty-six of the electric roads use three-quarter inch wheel flange and under on 2,244 miles of road, and 24 roads use seven-eighths inch flange on 256 miles of track. By combining these roads, increasing the depth of wheel flanges below three-quarter inch to that point, and cutting down the seven-eighths inch flange to three-quarter inch, we would have 2,500 miles of track using our standard, or 95 per cent. of reported electric track.

We find, then, that the wheel tread that most nearly approaches the necessities of the street railway world of to-day is a 2¼ inch tread, and the wheel flange three-quarters inch deep. Recognize this fact and the apparent need is for a rail designed to carry such a wheel. Such a rail should have, in my opinion, a head flat, or nearly so, $2\frac{5}{16}$ inches wide, with a curve not over one-quarter inch on the gauge line corner, with a dip of 1 inch to the wagon flange in side bearing rails, and 1⅛ inch to bottom of groove in groove rails. The width of the head and the gauge line curve can be made alike in both T and girder rails. Distance from centre line of web to gauge line in girder rail five-sixteenths inch. My reason for making the groove deeper than the dip inside of the bearing rail is that in the latter both head and flange are subject to wear, while in the groove rail the wear is confined to the head of the rail until the wheel flange strikes the bottom of the groove.

Such standard rail head I believe to be perfectly feasible. Its adoption by the association would materially simplify both the track and wheel questions. It would give to manufacturers a clear idea of what street railway requirements are likely to be, and enable them to have such rails as may be desired ready for next spring's business; and it would be of incalculable benefit in connection with such suggestions as those of Mr. Mansfield, already referred to, in enabling the many new companies to avoid the mistakes of inexperience to work with us toward a higher standard of excellence in street railway work.

*Abstract of a paper read at the Cleveland meeting of the American Street Railway Association.

Economy of Machine Shops for Electric Street Railways.*

BY JOHN F. BICKFORD.

The evolution of the electric motor has been so rapid that no definite methods have yet been established for its care and maintenance. There is a great lack of uniformity in the operation of roads, and one can hardly find two which are following the same course as regards repairs and renewals to motor equipment.

Outside of conductors, drivers and subordinates officers, the help on a horse line can be of a class which does not command a high rate of wages. Stablemen and trackmen are as a general thing employed for their muscle; therefore, I am not far from the truth when I say that previous to the introduction of electricity our street railroads were conducted with inexpensive help, and we have come to look upon this method as the only truly economical one. I do not present this as a criticism, only as a comparison.

What shall we do now? Still employ the same class of help? Is it wise to place this apparatus in the hands of men who do not understand the first law of mechanics? No; emphatically, no; it would be the height of folly, yet I am sorry to say that such was the case with some of our roads in the early days of electrics. The laboring man is all right in his place, and is a necessary adjunct to a railroad, but until he educates himself to the level of the mechanic he should not be allowed to handle, much less repair, the delicate mechanism of an electric motor. Heretofore, then, we have been dealing with muscle, now we must have brains; hence we must turn our attention to the mechanic and the engineer.

Let us take one step more and look at the mechanic, and see if we should discriminate between men of this calling. We have two classes of mechanics: the thoroughly skilled class, and the partially skilled class; the latter more commonly called handy men.

We have heard the old adage, "Jack of all trades and good at none," and do you not think that there is a grain of truth in it? However, there are exceptions in this class; some men are born mechanics, and could they have had the proper training, would have become even more skilled then their brethren of the other class. Such men are worth employing for some purposes, but the man who can, in his own estimation, do anything from the building of a motor to the framing of a house, seldom proves to be capable of doing either, and the electric road is better off without him. He never gains in knowledge, because he is satisfied in his own mind that he knows it all now.

Therefore, I say, we must look still higher for a class of men to care for and repair our electric machinery, and in doing so can only fall back upon the skilled mechanic. By the term "skilled mechanic" I do not necessarily mean a machinist. We have many kinds of mechanics. I mean a man who has learned a trade—has mastered some particular branch of the business, and applied himself to that exclusively. An armature winder is a skilled mechanic; so is a first-class lineman; that is his trade, he has mastered it and knows every condition that enters into it; the same with the machinist and the carpenter. Hence, I say again, these are the men we must employ if we want to run our roads properly and economically, and right here we see as stated a moment ago, that true economy does not consist in what we save at the start; it comes at the other end of the transaction; it is what we save in repairs and breakdowns, which can be very materially lessened by the employment of the right means.

Having thus arrived at the conclusion that skilled help is necessary to success, let us look still farther into the subject and ascertain what else is needed to bring about true economy. Just here is where opinion will divide, and is what renders this subject difficult of elucidation.

There is no denying the fact that to do a piece of work of any kind properly we must have proper tools; a makeshift in such a case only leads to the abominable temporary hitch. To do a thing half way results in gross extravagance in the end. There is no denying this; we have samples of it already on the electric railway. If this be true, what conclusion follows, in view of our previous conclusion—that we must employ the skilled mechanic?—simply that we must provide him with the requisite tools and machinery to do the work in a skillful manner.

Now that we have arrived at this latter conclusion, there is yet another step, the last, but by no means the least. It is this: How far shall we carry this equipment of the machine shop? Shall we make it a manufacturing establishment? There is surely a point here where we must draw the line. There is a distinction between repairs and renewals, but for all this the question arises whether, if we go so far as to establish a shop for repairs, is it best to go a little further and manufacture supply parts?

*Abstract of a report of a committee of the American Street Railway Association read at their Cleveland meeting.

In this connection I wish to call your attention to the methods and practices of the steam railroads. It seems to me that we ought to a certain extent to be guided by these people. They have spent over half a century in probing and sounding this matter of repairs and renewals, and even though we may not wish to follow their example in some things, it will surely be worth our while to consider what they are doing. We find here what we have arrived at through our conclusions, viz.: complete repair shops equipped with all the necessary machinery for doing the work in a thorough and economical manner and manned by competent help; furthermore, a thoroughly competent master mechanic at the head of the whole. We find them manufacturing a great many supply parts, even complete cars and locomotives, and everything necessary for the maintenance of the road. They have learned by experience that it is economical to manufacture in this way. This is shown by their still continuing to do so, and, so far as certain repairs are concerned, they know positively that such can be done in their own shops more satisfactorily than in a local machine shop. Their own men having become familiar with all the requirements of the work, they know every condition under which the apparatus has to work, consequently the successful and economical operation of the road, so far as this department is concerned, is assured. In some instances it may cost a trifle more to make the article than it could be bought for. Suppose it does. If it will give better service and wear longer, it is more economical. As I said at the beginning, economy does not always consist in buying a thing cheap. Happily, however, in the experience of the steam roads they have found that it costs no more, and in many cases not so much, as to buy of supply companies, which is surely a conclusive proof that it is economical to maintain shops.

After viewing the experience of the steam roads, let us turn our attention to the substantial practical data which I have gathered from the more prominent electric roads. Among these answers received from 66 roads I have found many things to strengthen my belief that it is economical to maintain a machine shop, not only for repairs but for the manufacture of supply parts. It turns out to be a fact that no less than 24 roads are maintaining machine shops, doing all their own repairs and manufacturing many supply parts. They say unhesitatingly that there is economy in so doing. They give as their reasons: First, that they can make better material than they can buy; that they are perfectly familiar with the requirements and conditions of the business; they are operating the roads and are in a position to know just what is needed, and are better able to judge of the strength and durability of the apparatus than those who have never been in a similar position. Is not this a natural consequence? A second reason given is, that there is a saving of from 25 to 50 per cent. by manufacturing the majority of parts.

What further, then, can we say? Is not this, coupled with the experience of the steam roads, sufficient to enable us to conclude that there must be economy in machine shops for electric street railways?

Out of the 66 roads heard from, 36 were winding their own motor armatures and field coils, and the cost of armatures varied from $17, the lowest, to $75, the highest; the average was about $35, including all labor and material. Fifteen roads had woodworking machinery, consisting principally of saw table, band saw, surface planer and mortising machine. Seven roads are cutting their gears, but some of them find it no cheaper than to buy. They think, however, that the work and material are better, and for that reason it pays them. Others make all gears and think there is a saving in cost. Eight roads are building their cars, while several are rebuilding old cars, but make no new ones.

I will give now a few of the prices for which supply parts are being made in the shops of the different roads. These figures are an average taken from 11 roads which are using Sprague, Thomson-Houston and Westinghouse double reduction motors.

Refilling commutator (copper bars)	$18.50
Two halves armature bearing, T.-H., $3.96, single Sprague	1.85
Two halves axle bearing	3.50
Brush holder	1.35
Rocker arm, T.-H., $1.00; Sprague	3.00
Int. shaft (steel), T.-H., $10; Sprague	3.00
Int. pinion (steel)	4.20
Int. gear	3.88
Axle gear	5.66
Armature pinion (steel)	3.58
Trolley wheel (brass)	1.06
Line frog	1.90
Clips for line hangers (brass)	.15
To bore and press on 30-inch wheel	.95

The average price for which roads sell scrap car wheels is $13.65 per gross ton; the lowest being $8 and the highest $20.

Being anxious to know myself, and thinking it might be of benefit to many others, I asked the roads to give an opinion as to which of the different types of motors gave them the most trouble. With but two exceptions, the single reduction cost less to maintain.

Nineteen roads are employing an electrical engineer, and four have a superintendent and electrical engineer combined.

I will not attempt to recommend the number and kind of machines a road ought to have, as it will depend largely on the number of cars they operate; but I have made up a list of machines which I find the majority of those having machine shops are using, and should judge that it covers those most necessary for the work;

One 20-inch swing, 10-foot bed, engine lathe; one 16-inch swing, 6-foot bed, engine lathe; one 16-inch swing, 6-foot bed, speed lathe; one 24-inch by 24-inch iron planer; one No. 3 or No. 4 Universal milling machine; one 45-inch upright boring mill; one 24-inch upright drill press; one 12-inch upright drill press; one 100-ton hydraulic wheel press; one open die bolt cutter and nut tapper; one medium size shaper; one tool grinder; two forges with power blower; one set of emery grinders; one grindstone; necessary bench tools and fittings for machines; one 10-h. p. motor to run machinery. Of course, roads with a greater number of cars would need to duplicate some of these machines and add some others not mentioned.

After having considered this subject and shown you what conclusions have been arrived at, both theoretically and practically, I want to add, that in order to make a success of running a machine shop in connection with an electric road it will be necessary to employ an electrical engineer. By this I do not mean a handy man, or a man who styles himself an electrician, just because he has had a few months' experience in the electrical business, but one who has a theoretical, as well as a practical, knowledge of mechanical and electrical engineering.

Experiments on the Expansion of Continuous Rails.*

BY A. J. MOXHAM.

In the matter of track construction to-day the question of paramount importance is that of the joint. For many years the question has been the rail. As this has received time and attention, one weak spot after another has been eliminated, and so great has been the pruning process that the one weak spot left, "the joint," is only the more glaring from the absence of many of its brothers in misfortune.

The question of a good joint is embodied in very few words, to wit, "absence of motion;" and it must be absence of motion of the cars as well as of the rails, particularly in the case of electric roads. If two rails be placed in perfect surface and alignment and closely abutted, and so held, the problem is solved. Not only must they be true to surface and line, but they must be abutted. It will not do to leave the usual expansion space.

After reviewing the evolution of the rail joint the author states:

The joint of to-day is structurally stiff, heavy enough to take up the jar of the blow without transmitting it all to the nuts, a yielding fit that tends to counteract all motion, and large bolts, carefully located with a view to vibration. In itself good, and it now stands, to a certain extent, capable of economical use, and far ahead of its brother on the steam road, even of the heaviest construction. But even so it will not do. If not, query "What then?" There is but one answer. No joint at all. While apparently a bold suggestion, it is at least worthy of thought and discussion. That the rail can be made continuous by mechanical means we know, but what of expansion and contraction. We will do without it; and that we can do so, the sequel I think will show.

To the credit of Mr. Philip Noonan, I think, belongs the first practical idea of a continuous rail. His theory, in a nutshell, may be described as gripping the rail at one end and permitting the wave motion or flow induced by passing trains to be, so to speak, rolled out before the train wheels, into a tension device that within certain limits holds what it gets. He provides against danger of rupture by a spring device which limits the strain. He put his ideas to a test, built a considerable stretch of track (some three miles) on the Lynchburg & Durham Railroad, at or near Gladys Station, Va., and it to-day is in successful use. Expert investigation and report indorses it in all essential particulars, though it is perhaps questionable whether the fastenings he used to make his rail continuous are strong and rigid enough to prohibit all yield. For details, those who care to investigate may be referred to a pamphlet on the subject, that can be obtained by addressing the inventor at the above-named place.

At a glance the problem of a street railway differs from the steam road in that the former is surrounded by the roadbed, while the latter is, at least to a great extent, exposed. The effect of the surrounding roadbed is twofold.

First—By its great surface friction it tends to hold the rail against change, stops all wave motion, and

Second—It to some extent modifies the temperature.

The problem was to find a measure of value for both. To this end the following experiment was made.

[The author then describes in detail an experiment in which a continuous rail was constructed and a long series of many thousands of readings of temperature taken of the air and of different parts of the roadbed and track. In drawing his conclusions he says]:

The experiment has proved absolutely and beyond cavil that the track is restrained and held by the surface friction of the surrounding roadbed. From first to last from a temperature of 22 degrees below freezing point (or 10 degrees) to a temperature of 89 degrees above freezing point (or 121 degrees), extending from March to August, there was absolutely no movement of the track out of place. Even at the ends this was true; proving that not only will the roadbed hold the track as a complete structure, but that it will do it consecutively. Once bedded it will hold a rail 10 feet or 30 feet, as well as one 1,100 feet. On this point there is no room for error. The expansion in 1,100 feet, if not neutralized, would equal 5¼ inches under the conditions here stated, and 5¼ inches would throw the rail out of line 14 feet if it were held at the ends and permitted to bow in the centre. An expansion of one rail would mean about 6 inches in 30 feet out of line. The query arises, "What has become of it?" It is existent, and, like all force, it would flow to the point of least resistance. In the case of a street rail, buried in the roadbed, it is reasonable to believe this point is in a minute enlargement and reduction of the sectional area of the rail.

As to its effect upon the steel: Experts teach us that a variation of 7 degrees in temperature, if held, would subject the rail to a stress of 1,000 pounds per square inch. Taking a track laid at the low temperature of 40 degrees and subject to a maximum of 120 degrees, or a variation of 80 degrees, the stress is equal to less than 12,000 pounds per square inch, much less than the elastic limit and less than the strain put upon an ordinary bridge, or similar structure. It would therefore appear that the effect on the steel would be harmless.

On the face of it, therefore, there is nothing to prevent us abutting our rails, and this is but the prelude to an absolutely continuous track—one without joints—the rails welded by electricity, or otherwise connected one to the other, up to such lengths as may be deemed best.

As to its practical application, many precautions suggest themselves. It must be remembered that a track so laid will be like a huge spring under tension, absolutely safe and harmless when restrained by the roadbed, but ready to spring like a shot from a cannon if, while in this condition, the roadbed be removed.

One important saving that would be effected by a "track without joints" would be in the weight of the rail. A rail of 100 pounds per yard is to-day in use, and next year will be extensively used. Perhaps without their knowledge, the cause of this has been the street railroad men's dearly bought and sad experience with joints. The joint being defective, the effort has been made to secure such stability of track as to relieve the joints by means of a heavy rail. In a 100 pound rail there are but 30 pounds of wearing surface, of which not more than 18 pounds can be used before the rail will have to be thrown out; therefore there will be 82 pounds unused. For mere stiffness and rigidity, a 66 pound rail, if supported by the proper number of cross-ties, will answer every engineering demand, even of electric cars at high speed. Anything over this goes to the debit of "bad joints."

*Abstract of a paper read at the Cleveland meeting of the American Street Railway Association.

Standards for Electric Street Railways.*

BY O. T. CROSBY.

The committee, of which, as chairman, I now desire to render the report, was named in the president's letter of January 4, 1892, and addressed to the undersigned. The scope of the committee's work, as set forth in that letter, and in the resolutions bearing on the subject adopted by the Association last October, is to report on the standardizing of rating, nomenclature, dimensions and accounts.

STANDARDIZING OF SPECIFIC DIMENSIONS.

In regard to this heading, I take pleasure in investing herewith the report of Mr. C. N. Wason, sub-committee on this subject:

"The object, as I understand it, of the Street Railway Convention is to enable the street railway men from different parts of the country to get together and exchange their views relative to various matters, with the idea of the mutual benefit to be derived from the discussion, and which would be impossible for the individuals to obtain did they not come together in this manner. Members of a committee like the Standardizing Committee have much work attending the bringing together of the matter desired, and it surely seems to me that each individual company should do all in its power to assist the committee by answering, to the best of its ability, any inquiries put to it by the members of such a committee through the mail.

"The data I here present have been gathered from railroads using possibly a lighter equipment than that which is now being put upon the market. It is absolutely impossible to standardize an appropriate size, considering the change of weight; but the following seems to be the best in the opinion of those from whom I had answers to my inquiries:

Diameter of axle, 3½ inches.
Diameter of car axle journal, 3 inches.
Diameter of axle wheel seat, 3⅛ inches.
Length of car axle journal, 8½ inches.
Diameter of car wheel, 33 inches.
Weight of car wheel, 350 pounds.
Diameter of trolley wheel, 4½ inches.
Width of trolley wheel, 1⅛ inches.
Depth of groove in trolley wheel when new, 1⅛ inches.
Size of key way for axle gear, ¾ inch by 6 inches.
Distance between hubs of wheels measured along the axle, 48 inches.

"It is essential that the groove and depth of trolley wheel be the same, if the cars run over the same style of switches, as it is almost impossible to put up an overhead construction that will carry all sorts of trolley wheels. This remark may at first look a little absurd, but when one has had much experience with several different size trolley wheels he will at once appreciate the necessity of all being alike."

The dimensions above recommended as standard have been approved by the other members of the committee to whom they have been submitted, except that Mr. Rugg prefers a 30-inch wheel instead of a 33-inch to be considered

*Abstract of the report of a committee of the American Street Railway Association, read at the Cleveland meeting.

as standard. It will be seen in studying the articles above referred to that those have been chosen which, if of varying dimensions, interfere most with the interchangeability of parts in an electric railway equipment. The object held in view was so to standardize dimensions as to produce as little inconvenience as possible when apparatus such as trucks, trolleys, motors, etc., are obtained for use on the same railway from different manufacturers. The dimensions of wheels and trolleys above given are intended to be applicable alike to single truck and double truck cars.

Concerning another mechanical dimension, consideration of which was referred especially to the writer, I am able to report that a large majority of the numerous persons addressed by me upon the subject recommended No. 0 B. & S. gauge as the best size for standard trolley wire. It is further understood that such trolley wire shall be of hard drawn copper, its conductivity to be 98 per cent. of the standard in the usual tables used. Its tensile strength is close to 55,000 pounds per square inch.

NOMENCLATURE.

The list of names suggested by the writer in the paper last year (see THE ELECTRICAL WORLD, Oct. 31, 1891, p. 328) has been submitted to a number of railway officials, railway contractors and manufacturers of electrical goods. Some corrections of the list as presented last year have been recommended by various persons, and are herewith incorporated. The name now recommended appears first, and after it, in parenthesis, is the one heretofore used for some articles.

NOMENCLATURE OF ELECTRIC RAILWAY TERMS.

Generator (Generator, dynamo)—Machine in which the electric current is generated.

Motor (Motor)—Machine in which the electric current is transformed into mechanical power.

Frame (Frame)—Iron body of machine, including pole pieces and standards or side arms, if any, but not including base plates and bearings.

Standards (Standard brackets)—Supports of the bearings of generator.

Side Arms (Side arms, check pieces, armature bracket)—Supports of bearing of railway motors.

Pole Pieces (Pole pieces)—That part of the frame from whose surface lines of force may pass directly to the armature.

Field Coil (Field coil, spool)—Coils of wires wound on frame in such a way that a current passing through these coils makes magnets of the frame and pole pieces.

Brush Holder—Device for holding the brushes in contact with the commutator, including the insulation used in its support.

Rocker Arm (Yoke, rocker arm) – Device for holding brush holders in position on commutator, while attaching it directly or indirectly to the frame.

Fuse (Fuse, fusible plug)—A metal device for opening circuit when the current becomes abnormally large, the soft metal being melted by a current of fixed quantity.

Switch—A device for closing or opening a circuit at one or more points.

Rheostat (Resistance box, rheostat)—Wire or other material suitably protected and conveniently arranged to be introduced in more or less proportion into a circuit.

Trolley (Trolley contact bar)—A device used to transmit the electric current from the overhead wire to the cars, consisting usually of a

Trolley Wheel—A small metal wheel making rolling contact with the overhead wire.

Trolley Fork—Mechanically connecting trolley wheel to

Trolley Pole—Supporting the trolley fork and wheel and resting in a socket which is part of the

Trolley Base Frame.

Trolley Wire—Wire from which the trolley wheel directly receives current.

Standard Trolley Switch (Trolley frog, frog, overhead switch)—A device used to fasten or hold together the trolley wires at a point where the trolley wire branches, and to guide ordinarily automatically the trolley wheel along the wire over the track taken by the car.

Trolley Switch—A switch designed for use at a point where two branch lines make equal convergent angles with the main line.

Right Hand Trolley Switch—A trolley switch designed for use at a point where a branch trolley wire leaves the main line to the right in the going direction.

Left Hand Trolley Switch—A trolley switch designed for use at a point where a branch trolley wire leaves the main line to the left in the going direction.

Three-Way Trolley Switch—A trolley switch for use at a point where the line branches in three directions.

Drawbridge Crossover—A device permitting the easy passage of a trolley wheel from one to the other of two adjacent wires in a continuous direction.

Trolley Frog (Trolley crossing, crossing frog, crossover)—A device placed at the crossing of two trolley wires, by which the trolley wheel running on one wire may cross the other, the device also holding the two trolley wires together.

Insulated Trolley Frog (Insulated trolley crossing)—A device placed at the crossing of two trolley wires, by which the two wires are insulated from each other, and by which the trolley wheel running one line may cross the other.

Hanger (Line insulator, line suspension, trolley insulator)—A device for supporting and insulating the trolley wire.

Straight Line Hanger—The hanger used on a straight line and supported from a span wire, the strain on same being essentially vertical.

Single Curve Pull-Off (Single curve hanger)—The hanger supported by a lateral strain in one direction and, ordinarily, on single track curves, except at ends and the inside curve of double track.

Double Curve Pull-Off (Double curve hanger)—The hanger supported by a lateral strain in opposite directions, used ordinarily at ends of both single and double curves and at intermediate points and on double track curves.

Feeder Clip (Feeder clamp)—Clamp with a device by which a feed wire may be connected to the trolley wire.

Feeder.—A wire usually insulated, used for transmitting current from the power station to the mains or the trolley wire direct.

Mains—Wire usually insulated, serving for the distributing of current from the feeders to the trolley wire through tap wire.

Tap Wires—Wires to convey current from feeders or mains at the pole to a near point of the trolley wire.

Trolley Wire Section—(Trolley section)—A length of one trolley wire with or without branches, but continuous electrically.

Line Section A part of the overhead conducting system so insulated from other parts as to permit the supply of power to be separately controlled.

Section Box—A box containing section switches and fuses used for control of a trolley section or line section.

RATING OF MOTORS.

[After referring to the unanimity of opinion among all those interested regarding the great desirability of having a uniform rating of motors, and after quoting several paragraphs from his former paper (see THE ELECTRICAL WORLD, Oct. 31, 1891, p. 328), he states]:

The first condition which, in my opinion, should be connected by implication with any rating whatever is this: that the machine in question shall be able to perform its rated work indefinitely and under any condition of atmospheric temperature. There is, of course, room for honest differences of opinion in regard to this point. It is well known that the maximum demands for power in street railway service are not those which last for a considerable length of time. A certain manufacturer may thus argue to himself: "This machine which I am about to advertise is able to do 20 h. p. of work for half an hour, when the atmospheric temperature is 90 degrees. In my opinion this rate and time and temperature will not be exceeded in the conditions of regular service. Why, then, may I not call this a 20-h. p. motor? It is true, if I were building it for stationary work, in which generally the load to be carried is much more constant, I should adopt a different rating."

It would be possible to express this condition thus: that whatever the rate, it shall be possible to maintain that rate indefinitely under all conditions of atmospheric temperature, by stating that the windings of the armature shall never show more than a given excess of heat over atmospheric temperature.

There is again room for honest differences of opinion in regard to the efficiency with which a motor can do its rated work. Suppose the manufacturer has produced a machine which can do its maximum work for an indefinite time without undue rise of temperature. There is to-day no custom of the trade distinctly understood which would prevent him from rating the machine by this maximum capacity. And, again, in stating that the machine is of 15 h. p. capacity, even if there be agreement concerning efficiency and durability, there might be disagreement of much importance in regard to the speed at which work can be performed by the motor. If it has been so constructed that it can do 15 h. p. power of work only at some armature speed corresponding to a linear speed of the car either much above or much below the average speed of the car, then the information and motor may both be of little value for street railway service. Indeed, the use of the term "horse power" then has necessarily this uncertainty in it; the total number of foot pounds per minute, namely 33,000, may be made up in an indefinite number of ways by an infinite number of combinations of feet of travel and pounds of pull; but for hour service we should have some known relation between these two.

It seems to me that that which the purchaser has in mind to obtain is such horizontal effort exerted at such a speed and at such an efficiency as will do the work in view. Now, the work in view varies very widely, and we cannot, therefore, obtain a convenient rating which will express this relation throughout the range of the total capacity of the motor. We may, however, select some particular condition, say that approaching as nearly as possible to the average, and tell by a method of rating, which I will propose, what the machine can do for such condition.

Let us first consider the speed at which it is desirable to know the capacity of the motor. I think 10 miles per hour is not far from the speed at which cars will be found most frequently running. If, then, we state concerning a motor that it can develop so much horizontal effort at that speed, we at once have a pretty close approximation as to what load of a car and passengers it can handle at that speed, since we know that 25 pounds per ton is a fair approximation to the average traction coefficient. Suppose, then, we are told that a motor can produce a horizontal effort of 500 pounds at 10 miles an hour; it is then a quick inference that a car weighing 20 tons can be carried by such a motor at the rate of 10 miles per hour on a level. We may then conscientiously call this motor a "500 × 10."

It may, of course, at once be objected that such a method does not distinguish between efficiency of motor proper and the efficiency of its gearing. For a great many reasons this is not very objectionable. We buy the motor with its gearing, and I can see no particular reason why the manufacturer should not get the benefit or the blame of the good or bad gearing which he may use with his efficient or inefficient motor. Furthermore, in the single reduction motors, now so widely used for ordinary street railway work, the loss by gearing transmission is very small, and probably not widely variant as between the different manufacturers; and again, in whatever high speed work which it may be feasible to do by gearless motors, the question of the efficiency or inefficiency of the gear is eliminated.

Again, it may be objected that such a method supposes uniform diameter of wheel, which must be known to the manufacturer in order that he may calculate what his motor is doing for a given car speed. Should there be no considerable variation from the 30-inch wheel now so largely used, such a diameter might be taken for granted as having entered the calculation; and if a different wheel, say 33-inch, becomes general, then that diameter may be assumed in the rating.

It would, of course, in any such rating, be assumed that the machine is working under a pressure of 450 volts, which is not far from that found on most of the lines throughout this country. In the necessary regulation to which these motors are subjected, a part of this pressure is practically applied to some resistance, external or internal, with respect to the motor; but I can see no convenient way of taking this into account in determining upon a rating. Indeed, the action of a series motor in street railway service is very complex, and it is much more difficult than sometimes supposed to determine upon a rating which shall give the greatest amount of available information. The very difficulty, however, is warrant for approaching the subject seriously and industriously.

In spite of the fact that many objections may be urged against any suggested method of rating, that which is preferred by your committee and by many persons consulted in regard to the question is this: That a motor shall be known as to its capacity by the horizontal effort which it can apply to a car at a speed of 10 miles per hour, the standard 33-inch wheels above recommended being used on the car, and whatever gearing may be preferred by the manufacturer. It is plain that the horizontal effort that may thus be produced from a given motor whose armature is running at a given speed may be made to vary by this change of gearing, but for the reasons above stated it has been thought best to consider the motor and its gearing as one piece of mechanism. While the recommendation would at first involve the use of two terms in the name of a motor, namely, horizontal effort and speed, the term for speed would soon disappear after it has become generally understood to be 10 miles per hour. Thus for the present, calling a given motor 600 × 10; this meaning that at a speed of 10 miles per hour the motor in question will develop a horizontal effort of 600 pounds. Later, however, the same machine would be satisfactorily designated as a 600-pound motor, the standard speed being taken for granted. At the same time as street railway men begin to go into suburban enterprises, in which higher speeds than those now familiar must be attempted, it will be easy to revive the expression for the speed at which a motor is rated, and we may thus expect to see motors described as 600 × 20, 600 × 30, etc. This high speed extension of electrical motor work, and especially its extension in the same hands as those now directing ordinary street traffic, makes it especially important that some rating should be adopted which will take speed into account, as otherwise confusion will inevitably result. It goes without saying that much remains to be told concerning a motor after its horizontal effort at a given speed shall be expressed, and a part of the recommendation of your committee is that an implied part of the rating of a motor lies in this, that it shall be able to perform its rated work continuously without a rise of temperature exceeding 75 degrees C. over the atmospheric temperature.

In regard to the efficiency, desirable as it is to be informed on that point, it seems too difficult to be involved in any rating which shall be frequently and properly used.

Another method of rating motors which is presented as the second choice of your committee is as follows: that two terms should be used, one giving the horse power of the motor at which it can work continuously at a safe temperature, the other its maximum horse power. As has been explained, it is a feature of all electric motors that their maximum rate of work is done at a 50 per cent. efficiency. Nothing is more essential to be established, therefore, than the maximum work the motor will do. Following this method, which was suggested by Mr. Chas. A. Lieb, a given motor might be known as 15 × 35 or as 20 × 40, etc., concerning the first machine named it being understood that it could do 15 h. p. of work all day long without undue heating, but under stress it could perform work at the rate of 35 h. p., the efficiency being at once known to be down to 50 per cent. It would also be understood, and go almost without saying, that the motor would be unable to do 35 h. p. of work continuously; indeed it would be expected to perform such a rate of work safely for only a very short time, say from two to five minutes.

Little has been gained in what we believe all recognize as a useful work, if we stop at a formal adoption of names and dimensions. A constant and well directed presentation of the association standards by some proper official will do much to increase the value of whatever action you may take. Some presentation should be made, not only to members of the association, but also to manufacturers interested in the standards that may be adopted. As a preliminary step to the extension of this work, we recommend that copies of this report and of your action upon it be sent broadly to manufacturers, contractors and dealers in electrical railway supplies. We further suggest in so far as you may adopt any of the standards herein recommended, that you should urge manufacturers and dealers to make their catalogues conform with your recommendations in the details touched upon; and we further urge that the association shall urge its members to keep before them the standards that may be thus adopted and that they shall insist upon the obtainment of the use of these standards by the manufacturers and dealers in so far as possible.

STANDARDIZING OF ACCOUNTS, ACCOUNTING METHODS AND STATISTICS.

[The following is the report of Mr. H. I. Bettis, the subcommittee on this subject]:

The ultimate object of all accounting is to ascertain with accuracy the amount of net income after all operating expenses and fixed charges have been paid. With this object in view, and no other, the art would be reduced to a very

simple profit and loss account, debited with all expenses and credited with the entire income; but the owners and managers of our street railway properties for many reasons desire some further information than this. It is not sufficient for them to know that their road has a certain income or that the expense has reached a certain amount. They desire to know many things in addition to these: what was the source of income; how many miles of track they have; how many cars; how many trips those cars make; how many passengers they carry; what other sources of income were there; what was the expense of operating the road; what portion was simply for the transportation of the passengers; how much was paid for motive power, for repair of cars, of apparatus, of track, buildings, etc., etc.; has anything been expended in construction, improvements or betterments. Having all this information well in hand, the owners and managers can determine more readily wherein the expenses have been too large, and have thereafter a basis upon which to calculate their future operations. Moreover, what is of incalculable benefit, they can compare the cost of operating expenses of other lines throughout the country.

Heretofore the great difference of opinion on the part of street railway officials as to the necessity or value of any reports, or statistical information, has rendered it almost impossible to get any reliable information, and, above all, to make any comparisons, one road with another. In order to get any beneficial results by comparison it is necessary thatwe have statistics compiled from some standard basis. We cannot compare wheat with potatoes, neither can we compare the cost of operation of one road with the operation of another, unless like expense accounts are included in each case and the data compiled under the same rules.

This committee will not attempt to prescribe a set of rules and reports, but only to suggest certain distinctive lines which we believe should be followed in the future when deciding upon a basis for accounting statistics.

DIVISION OF EXPENSES.

We are all agreed that it is essential for the expenses which add to the present or future value of a property to be separated from those which do not, and that the three great divisions should be:

1. Transportation expenses.
2. Maintenance expenses.
3. Construction expenses.

This established, the various subdivisions may be few or carried to infinity, but the final results are necessarily the same.

The difference between these divisions is as follows: 1. *Transportation expense* is simply the expense of transporting the passengers, and includes nothing whatever expended upon the property. Under this heading we should find wages of conductors, drivers, gripmen, motormen (engineers and firemen on dummy lines), fuel, provender, lubricants, wrecking, etc., etc. 2. *Maintenance expense* is the expense of keeping the properties in their original condition, and consists of the amounts expended upon repairs of track, buildings, cars, power plant, engines, etc., etc. 3. *Construction expense* is such as adds to the value of the original plant, such as additional buildings and machinery, new tracks laid, less the value of the old ones taken up, etc., etc.

Improvements and betterments should also be included under the head of construction, that is, for such portion as the property is improved over the first cost.

One question deserving your consideration is that of taxes, and whether it should be included in the operating expenses or not. I have noticed that the majority of the roads do now include it, while a few deduct it from the net income after operating expenses. In comparative statements this is an important item, and it would be well to decide this question. Our road deducts taxes after the operating expenses as one of the fixed charges, which I think is correct.

MATERIAL.

Another point we would suggest is to recommend the accounting for material as closely as possible. It is the practice upon many roads to keep no account of material purchased and kept in stock for future use, but to charge all material purchased to expense, whether used at once or not. It must be perfectly clear to this convention that when material is purchased, there is no decrease in the assets of the company and consequently no expense. There has been simply an exchange of cash for material. The expense does not occur until the material is used.

When we can impress upon our accounting officers the necessity of accounting for material as closely as for the paltry nickel, we shall have advanced one important step in the right direction; and until this is accomplished, our monthly returns will not show us what they are intended to show, *i. e.*, the business done and the expenses incurred during the month.

It is absurd to charge to the expenses of one month all the bills paid in that month, or the bills contracted in that month, when the material covered by the same may have been used long ago, or may be in stock and for future use. Material used represents from 30 to 40 per cent. of the expenses of operation, and yet on the majority of our roads it receives no attention whatever.

I would like to say something concerning the care of material, the method of handling supplies, method of keeping stock accounts, of the care of tools and old material, but fear to take too much of your valuable time upon subjects of minor importance.

UNIT FOR COMPARISON.

It has been suggested that we adopt as a unit for comparison the car mile, especially in regard to motive power, and consider the single truck with double motor car as the standard, double truck cars to be equal to two trains of two cars each.

It is difficult to say what should be the unit, whether it should be the car mile, the passenger or neither. When we consider the vastly different conditions to be contended with on the various roads, in the shape of grades, distances from power house, amount of traffic, etc., we can hardly settle upon any factor for a unit.

It may be decided that the best results for comparison will be found by comparing the percentage which operation bears to gross income.

Relative Cost of Operation of Horse, Cable and Electric Roads.*

BY WM. M. RAMSEY, FRANK R. GREENE AND JOHN L. HEINS.

The work which the committee had to perform was to ascertain from leading horse roads, cable roads and electric roads such information regarding the cost of operation of each as the existing methods of accounting in each case made possible. They recognized in the early stages of their work that any attempt on their part to shape the accounts of the companies to suit the purpose of the committee would be fruitless, for reasons which must be obvious to all. A series of questions were framed comprehending the information desired, and with such subdivisions of operating expenses as it was thought would meet with most ready reply. Our experience has proved that the subdivisions were well selected, for many of the replies were as full and concise as could be desired.

It is with regret that the committee announces that the information received from horse roads, for various causes, is meagre and unsatisfactory. It was not the intention of the committee to pass superficially over the horse roads, as our report would seem to indicate.

Many of the replies sent to the committee were given for the personal consideration of the committee alone, and not for publication or public reference in any way. We have, however, chosen a few of the representative roads of each class, and have tabulated the replies in such a way that reference can be made to them by number if desired.

A comparison of the reports from these roads does not reveal the characteristics which we should expect to find. We see results which are as varied as could be imagined. Why should cable road No. 1, earning only 18 cents per car mile, have within 8 cents per car mile as much to divide among its stockholders as road No. 3, having nearly 12 cents per car mile more receipts? Let us refer to the reports of these two roads and make a few comparisons.

The first noticeable difference in the conditions under which the two roads operate lies in the fact that road No. 1 operates daily an average of 298 trail or tow cars, while road No. 3 operates only grip cars. Road No. 1 operates 1.54 tow cars for every grip car operated, or a daily mileage of 203.2 for every train of one grip car and 1.54 tow cars to every 100 miles made by a train of one grip car only, which road No. 3 operates. Now if the expense of operating increased *directly* as the mileage, whether made by grip or by tow cars, a direct comparison of these two roads would be possible; but such is not the case. Road No. 3 is evidently at a disadvantage. The same difficulty occurs in the comparison of certain electric roads with one another.

A very excellent method of correcting this error has been formulated by Dr. Cary T. Hutchinson, and is here presented by his kind permission. It is evident that what is wanted is a formula which will represent the ratio of cost per car mile, as ordinarily counted, to cost per motor car mile, for any item of expense.

Dr. Hutchinson's method is as follows:

Let t = Number of miles a train of two cars runs per day.
" m = Number of miles a motor car alone runs per day.
" a = cost per train mile for any special item, *e. g.*, cost of fuel.
" b = cost per motor car mile for the same item.
" $n = 2t + m$ = car miles, as ordinarily counted.
" $r = a/b$ = ratio of cost per train mile to cost per motor car mile for any given item.
" c = cost per car mile, counting trailers same as motor cars. This is the figure ordinarily given.
" cn = total cost of operating line per day—for that item.

Then $at + bm = cn$ for any item of expense; but $a = br$

and therefore $b(tr + m) = cn$ or $b = \dfrac{cn}{tr + m}$

or
$$b = \frac{c}{r\frac{t}{n} + \frac{m}{n}} \qquad (1)$$

and
$$a = rb \qquad (2)$$

Now $\frac{t}{n}$ and $\frac{m}{n}$, the ratios of train and motor to total mileage, are known.

Then r must be determined for each item of expense.

I take for r the following values:

First—Maintenance of roadbed and track, $r = 1.5$; although there are two cars instead of one, yet the trail car is by no means as hard on the rails as is the motor car.

Second—Maintenance of line, $r = 1$. It is the same whether there is or is not a trail car.

Third—Maintenance of power plant, $r = 1.4$. Because I have found by experience that under average conditions a train requires about 1.4 times the power of a motor car, and maintenance should be assumed proportional to power developed.

Fourth—Cost of power, fuel and supplies, $r = 1.4$, as above. Attendants, $r = 1$. Because for a good sized plant no more men would have to be employed in the power house if all the cars hauled trailers; the force required is not proportional to the output, but is constant within pretty wide limits.

Fifth—Maintenance of rolling stock. Repairs to motors, $r = 1$. Repairs to cars and trucks, $r = 1.25$. Repairs to trail cars are very much less than to motor cars.

Sixth—Transportation expenses. Carmen, $r = 1.5$; three men on a train and two on a motor car. The rest may all be bunched at $r = 1.25$.

Seventh—General expenses, $r = 1$.

This method of comparison can be used satisfactorily for any roads, cable or electric, providing the necessary data has been obtained as to motor car miles and train miles, and providing experience and careful observation have enabled the investigator to assign approximately correct values for r, which will differ in different cases. But there are yet many discrepancies to explain, for which we must seek other reasons. Why should the gross operating expenses of No. 3 electric road exceed the gross receipts per car mile of No. 4 electric road by nearly 100 per cent., and yet both roads still have a fair percentage of the receipts left for dividends? No. 4 road is a small road, and No. 3 is a large one, but we cannot argue that small electric roads have a better chance for profits than large ones. It is fair to assert that study of No. 3 report would lead to the conclusion that either there is more in the road than is brought out of it, or that the only thing that justifies the outlay of 25¼ cents per car mile (trail car mileage included), is the receipt of over 40 cents per car mile, to do it with.

The quality of the management which any of our roads receives is an uncertain quantity, but must be assumed to be good in our arguments. The management of roads Nos. 1 and 3 in the cable list are known to the writer to be excellent. The other conditions under which the two roads operate are nearly the same. Yet a "figure of merit"—obtained by multiplying the total daily mileage by net earnings per car mile, and dividing by the amount of capital stock paid in—shows vastly in favor of No. 3 road, and this notwithstanding the gross operating expenses of No. 3 road are about 50 per cent. higher than the operating expenses of No. 1 road—both being placed on an equal basis of grip car miles. We see, therefore, that still another method of comparison must be resorted to in order to give an intelligent idea of the comparative earning power of two roads—namely: the comparative earning power per day of each dollar invested in each road. This ratio, when stated, comprehends all of the conditions under which the two roads operate; it is the final result of a compound proportion of which the ingredients are the investment, the outlay and the income—"outlay" comprehending the management and efficiency of the road, and "income" comprehending, among other things, the comparative value of the territories through which the roads pass.

Operating expenses per motor car mile, or per grip car mile, afford a satisfactory basis on which to compare expense of operation, but net earnings per motor or grip car mile tell us nothing of the value of a road as an investment, unless we know also the total investment necessary to earn so much per car mile; and we take occasion to remark here that future committees on this important topic will find it discouraging work to follow the usual lines of investigation into receipts, cost of operation and net earnings of street railways, and may find it necessary to look to some method of comparison by arbitrary "figure of merit," as has been suggested by several of our thinking engineers.

For a comparison of an average cable road with an average electric road, let us take this same No. 3 cable road, and compare it with No. 7 electric road. The cable road has been shown to be something better than the average, and the electric road is known to the writer to be at least up to the average. These two roads afford us a better opportunity than any other two which we might select, for the following reasons:

1st. Both are located in the same city, where climatic and other local conditions are the same. 2d. Both roads are of the same magnitude. 3d. Fuel and labor cost the same in each case. 4th. Neither road operates trail cars. The cable road has the advantage in route as to grades and curves; otherwise, the roads offer excellent opportunities for comparison. It might be added that the investment in each case is up to the average, that is, not extravagantly large, and yet ample for the business transacted. Each road may be regarded as typical of its class. We see, upon examination, that the cable road has the greater fixed charges by 1.7 cents. There is a difference of one cent in the gross receipts in favor of the cable road; one cent of which may be said to be due to the larger gross receipts; but resorting again to the comparison by "figure of merit," we find a ratio of .00015 to .00020, or nearly 3 to 4 in favor of the electric road. This simply means that each dollar invested in the cable road will earn .00015 in one day, whereas each dollar invested in the electric road will earn .00020 in one day. The total investment in the case of the cable road in this case is 2½ times the total investment in the case of the electric road. The capital stock alone, exclusive of bonds of the cable road, is 2.4 times the capital stock of the eleetric road.

What is our conclusion from these facts, or can we draw a conclusion on which we can stand? We have not been conservative in our statements thus far, but are, of course,

* Abstract of a report of a committee of the American Street Railway Association, read at the Cleveland meeting of the association.

TABLE NO. 1.—OPERATING EXPENSES, ETC., OF EIGHT CABLE ROADS.

No.	Average number of grip cars operated daily.	Average number of trail cars operated daily.	Daily mileage of grip cars.	Daily mileage of trail cars.	Receipts per car mile, including mileage of trail cars.	Fixed charges per car mile.	Interest on funded debt.	Taxes, tolls—State, county and municipal taxes, except water taxes.	Gross operating expenses per car mile, exclusive of fixed charges.	Maintenance of roadbed and track.	Maintenance of cable rope and underground machinery.	Maintenance of power plant, including repairs to engines, boilers, etc.	Maintenance of plant in gen'l, bldgs., etc.	Maintenance of rolling stock.	Maintenance of grips, including inspection and shop work.	Cost of power—fuel, water, oil, waste, and wages of employés.	Cost of transporta'n—conductors & motormen, lighting and heating cars, etc.	General expenses—salaries, legal, accidents, etc.	Net earnings per car mile.	Wages of conductors and gripmen per hour.	Kind of fuel used.	Cost per ton in dollars.
1	193	298	80	80	18.054	1.624	1.069	.555	8.810	.401	.686	.530	.132	.594	.084	.925	4.702	.756	7.620	28c.	Screenings.	1.47
2	30½	.....	127	.....	18.300	4.700	4.200	.500	13.700	.500	2.300	.100	.030	.300	.100	1.700	6.400	2.000	4.900	17c.	Slack & nut.	2.02
3	51	.....	109	.....	29.840	5.440	3.200	2.240	16.000	1.910	1.720	.190	.580	1.030	.570	1.070	7.450	1.480	8.400	18¾c.	Coal.	1.21½
4	6	6	90	90	15.10	.....	.....	.....	41.000	.....	.....	.....	.....	.....	.....	.....	7.000	3.000	.....	17¼c.	R. o. m.	2.00
5	7	7	70	70	19.80	.....	.659	1.210	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	29	58	104	104	.....	1.230	.990	.....	6.750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19½ and 20½	.....	.....
7	8	5	90.40	105.65	.....	1.884	1.532	0.352	10.715	.408	.734	.055	.....	.480	.263	2.530	4.984	1.221	.....	22½c.	Petroleum.	5½c. per gal.
8	70	70	123.54	123.54	.....	6.610	5.700	0.910	20.050	.400	3.000	.120	.100	.860	.540	3.240	9.890	1.900	.....	22c.	Soft coal.	6.20 net ton.

TABLE NO. 2.—OPERATING EXPENSES, ETC., OF SEVEN ELECTRIC ROADS.

No.	Average number of motor cars operated daily.	Average number of trail cars operated daily.	Average daily mileage of motor cars.	Av. daily milge of trail cars.	Receipts per car mile, including mileage of trail cars.	Fixed charges per car mile.	Interest on funded debt.	Taxes, tolls—State, county and municipal, except water taxes.	Gross operating expenses per car mile, exclusive of fix'd ch'rges.	Maintenance of road bed and track.	Maintenance of line work, including underground wiring.	Maintenance of power plant, repairs on engines, boilers, etc.	Maintenance of plant in gen'l, bldgs., etc.	Maintenance of rolling stock, car bodies, trucks, etc.	Maintenance of motors inspection and shop work, electr'l and mechan'l.	Cost of power—fuel, oil, waste, etc. Wages of employés.	Cost of transportation—wages of conductors, motormen, dispatchers, etc.	General expenses—salaries, legal accidents, etc.	Net earnings per car mile.	Wages of conductors and motor men per hour.	Kind of fuel used.	Cost per ton in dollars.
					Cents.	Cents.	Cts.	Cents.	Cents.	Cents.	Cents	Cents.	Cts.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.		
1.	39½	.....	127	.....	19.360	.....	.....	.....	9.690	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.670	15½	Slack at 1.90	Lump 3.00
2.	17	.....	89½	.....	25.263	7.222	6.861	.361	17.974	.773	.203	.411	.040	3,405		3.301	8.750	1.091	.0067	24	Wood.	By the year.
3.	280	5	70	56	40.280	3.360	1.000	2.380	25.440	2.520	.720	.380	.330	1.590	2.720	3.560	11.420	2.220	14.3400	22½	Lump coal.	3.92
4.	10	4	120	120	13.500	9.000	.....	.....	9.000	.....	.....	.....	.....	.....	.....	.....	1.500	.....	4.0000	12½	Soft coal.	1.25
5.	10	.....	100	.....	15.000	6.400	.....	.....	.....	.....	.....	.420	.....	1.230	2.360	3.200	.....	.....	3.4200	13	Soft coal.	1.32
6.	5	.....	96.6	.....	.....	.....	.....	.....	16.000	.110	.070	.....	.....	.740	.....	3.840	8.740	.620	5.2300	14	R. o. m.	3.00
7.	37	.....	100	.....	28.880	.....	2.560	.....	13.530	2.500	.520	.....	.....	2.360	2.380	2.840	6.900	2.210	6.6100	20½	Slack.	1.21

not infallible. "One swallow does not make a summer," nor do the examples we cite determine the whole matter once for all. The cable road has its place firmly established in the transportation business of the Pacific slope, and we, who are unacquainted with the conditions met with there, cannot presume to say that the electric railway would do the same work better and more efficiently. We are tempted to say so, but the interests concerned are too great to be trifled with in so dogmatic a manner. We recognize that the greatest value will be obtained from this report by members taking it home with them and studying the figures analytically. Another year may develop such improvements in methods of accounting that definite conclusions can be formed; but to do more than merely produce figures from typical roads, the committee is not prepared at this early stage of electric railroad practice. The cable roads have their methods pretty well digested, and their figures are, as a rule, reliable. The electric roads are as yet, with few exceptions published in this paper, in the dark as to what they are doing—except that they have enough left to satisfy stockholders—in fact 89 per cent. of the electric roads heard from report dividends of from 5 to 12 per cent.

We believe that cable road practice has reached the stage where but little room is left for improvement. They have been developed, improved and operated by the best engineering skill which the country affords. Nearly all are on a good dividend paying basis; but whatever the past experience of the two systems has been, or whatever the present status of the two may be, we are only voicing the convictions of well-informed engineers when we say that electric systems will continue to increase in efficiency (by which is meant earning capacity) until all rivals are distanced, and only one method of rapid transit is recognized—the electric car.

A Model Electric Street Railway Roadbed and Underground Wiring.*

BY GEORGE W. BAUMHOFF.

This subject embraces one of the most important questions connected with the construction and operation of a street railway and is one that should have the most thorough consideration, for upon the condition of the roadbed, more than any other item, depends the success of your enterprise. The motto should therefore be, "the best is none too good."

That we are all striving to obtain the best is evidenced by the fact that reports in relation to this very important branch of street railway construction have been earnestly discussed at former conventions of this association, and your committee feels inadequate to the task of presenting at this meeting a report that will not be a repetition of what has been so ably introduced by former committees of practical and experienced street railway managers and the numerous articles published by those interested in street railway publications.

The mistake is sometimes made in designing and equipping a new road, or in changing from animal traction to electricity, of neglecting the track construction by apportioning the amount to be thus expended to such a sum that, in order to make both ends meet, it becomes necessary to weaken that portion of the investment, where, above all others, strength and permanency are required.

Now, in no other branch of our business do the ends meet oftener than at rail joints, and when these joints are improperly constructed it results in meeting the bills for repairs to the same with monthly regularity. It is therefore essential that in the construction and maintenance of a perfect roadbed the best known type of rail be selected; consequently, your committee has decided in submitting this report to dwell chiefly on the merits of various types of rail known as the girder system, and in order to place the same before you in an intelligent manner will proceed with an itemized report in the order in which the construction is proceeded with.

First.—Survey.

*Report of a committee of the American Street Railway Association read at the Cleveland meeting.

Having decided on the style and weight of rail to be used, and the chairs, fastenings and joints for the same, the first step in order is to properly survey the route, if a new road; to estimate the quantity of cut and fill where grading is necessary and the most advantageous manner in which to provide for the same, and to locate all curves, switches and turnouts. In doing so, care should be exercised to provide for all curves the longest possible radius at points of entering and leaving the same, and to provide for the proper elevation of the outer rail of all curves, which should be elevated from one inch to two inches higher than the inner rail, where the condition of the street will permit; particularly in any curve of short radius, and more especially when such curve is located on a down grade.

The switches, or cross overs, should be located at such points along the route as will best provide for the following contingencies: bunching cars for large gatherings; and to insure the constant operation of cars during fires, parades and all other blockades when, from any cause, the terminus of the road cannot be reached. They should never be placed with the switch point against the traffic, and preferably on up grades, thus enabling cars to cross to the opposite track by gravity.

In ordering cross overs care should be taken to specify that the straight track rail be continuous, for in most work of this kind the reverse is the rule. The aim should be to favor the track most used.

Second.—Excavation.

The depth of excavation must be determined by the thickness of the cross tie, height of rail and height of chair, if chairs are used, plus the space allowed for tamping. The condition of the soil must govern the latter exclusively, but in the reconstruction of the roadbed, where the operation of cars will permit, and in all new work, unless the soil is of a sandy character, the following plan will not only provide a suitable sub-drainage, but insure permanency: Remove all earth to a depth of 8 inches below the bottom of the cross tie the full width of the trench; then roll thoroughly with a heavy four horse or steam roller; then spread with a layer of cinders, crushed rock, gravel or furnace slag, from 6 to 8 inches in thickness, and again roll until the same is well bedded and leveled. A trench 7 feet in width, with a layer of 8 inches, will require for one mile in length 24,640 cubic feet of material, estimated at 3½ cents = $862.40, and will require the removal of 912 yards of earth, estimated at 25 cents = $228; add for rolling, $50. Total, $1,140 per mile of single track.

The fact that the material so placed provides a splendid sub-drainage is the best argument in its favor, and one that will commend its adoption where soil demands it; for it is far more expensive to open up and re-tamp poorly constructed track than to properly construct and provide with sub-drainage at the outset. For surfacing, care should be taken to procure machine crushed rock or gravel, as it insures a more even bed under the tie than coarser material.

Third.—Cross Ties.

Under this heading we have the metallic tie and various kinds of wood. The committee's remarks will be confined to the latter exclusively, for it will be seen by reference to former reports on track repairs and construction, made to this convention, that the life of a wood tie when buried to a depth of eight inches or more is the best argument in favor of its adoption, as against the former. The various kinds of wood, and discussion of durability of the same, have also been submitted in former reports, and it is generally conceded that in the selection of the particular kind and quality of timber the purchaser is influenced by his own knowledge of the timber best adapted for various climates and sections of the country, exclusively.

The fact should, however, be borne in mind in the selection of cross ties, not only to keep in view the selection of such timber as is calculated to insure the longest life, but due consideration should be given to the particular kind that will best hold the spike; and for this reason the white oak possesses advantages that should merit its consideration. The size should never be less than 5×8 inches for rail 56 pounds and over, and if laid as closely as good tamping will permit—say 27 inches for centres—will materially strengthen the roadbed and assist in holding up the joints. For joints where wide joint chairs are adopted, one tie of sufficient width is preferable, as it is impossible to insure good tamping where two small ties are used at the joints. If the above size is decreased, it should be in thickness rather than in width, to insure it from spliting, which is often caused by the spike being driven too close to the edge.

Fourth.—Rail.

In the selection of the rail depends largely the success of perfect construction, and a road, whether built for speculative purposes or as a permanent investment by the projectors, should not be slighted in this respect.

The requirements of a rail for electric traction are strength, joint connections, durability. In some localities there are municipal requirements specifying what the head of the rail shall be. For strength, we rely chiefly on the weight of the rail and the thickness and depth of the web. For joint connections, that rail which affords the best method of keeping both ends of the rail in perfect alignment is the best, and as the girder rail possesses peculiar advantages in this respect, its almost universal adoption is due to that fact. For durability, we depend on the height of the head of the rail at the gauge line over the lower flange, and the quality of the metal. The former is invariably considered by the purchaser, but your committee is not aware of a single instance in which the quality of the metal has been specified, other than the mere mention of whether the same shall be of iron or steel.

In former years, when the old style stringer construction was in vogue, when a good stringer and cross tie would outlast two or more flat rails, iron was chiefly used, owing to its higher market value as scrap. In the construction of an electric railway, where the girder system has superseded the flat rail, steel is more extensively, if not exclusively, employed; therefore, when we have closed our contract, having duly specified steel, we feel assured that the best possible rail has been provided for.

That there is a very great variance in the mixture of the metal before being rolled is beyond contradiction. That there is also a difference of opinion among the various manufacturers as to the limit of percentage of carbon and other elements, particularly carbon, to be employed in attaining the most satisfactory results as to wearing qualities of the head of the rail, and yet prevent brittleness, is attested by replies to communications on this subject from a number of inquiries; and while the matter is of sufficient importance to warrant its introduction in this report, yet we do not deem it advisable from the data now before us to assume what constitutes the best composition for a rail. There are other elements to be considered besides carbon, as witnessed in the report of Dr. C. B. Dudley, from the proceedings of the New York meeting of the Iron and Steel Institute, October, 1890.

One of the largest steam railroad companies in this country, whose extensive testing laboratories enable them to thoroughly test all material purchased in the construction and operation of their railway, require that all steel rails furnished them shall be subject to specifications adopted by said company. Surely, if experience has taught them the wisdom of this precaution, where their rail is entirely above ground, and therefore more cheaply replaced than that of street railways, would it not be advisable for us to pause and reflect on this subject?

The specifications adopted by the company referred to are as follows:

1. The steel used for rails shall be made in accordance with the "pneumatic" or the "open-hearth" process, and contain not less than thirty nor more than fifty one-hundredths of one per cent. of carbon.
2. The result of the carbon test of each charge, of which the railroad company is to receive rails and of which an official record is kept at each mill, is to be exhibited to the rail inspector.
3. A test bar, three-quarters of an inch wide, and about 10 inches long, to be taken from the web of a rail made from each charge, is to be furnished to the railroad company's inspector, for use in making analysis and test of the steel whenever required.
4. The number of the charge and place and year of manufacture shall be marked in plain figures and letters on the side of the web of each rail.
5. The weight of rails shall be kept as near to standard weights adopted by the railroad as it is practicable to do so.
6. The sections of the rails shall correspond with the respective templates showing the shape and dimensions of the different rails adopted as standard as near as practicable after complying with section 5.
7. The space between the web of the rails and template representing the splice bar shall not be less than one-quarter of an inch, nor more than three-eighths of an inch.

8. Circular holes one inch in diameter shall be drilled through the web in the centre thereof, at equal distances from the upper surface of the flange and lower surface of the head, and one and one fifteen-sixteenths inches from the end of the rail to the centre of the first hole, and of five inches from the centre of the first hole to the centre of the second hole, and of six inches from the centre of the second hole to the centre of the third hole.

9. The lengths of rails at sixty degrees Fahrenheit shall be kept within one-quarter of an inch of the standard lengths which are thirty feet, twenty-seven and one-half feet, and twenty-five feet. When specially mentioned in the contract, and not otherwise, ten per cent. of rails of shorter lengths and five per cent. of second class rails will be accepted.

10. The rough edges produced at the ends of the rails by the saw shall be well trimmed off and filed.

11. All rails are to be straightened, in order to insure a perfectly straight track.

12. The causes for a temporary rejection of the rails are:
1. Crooked rails.
2. Imperfect ends, which, after being cut off, would give a perfect rail of one of the standard short lengths.
3. Missing test reports.
4. A variation of more than one-quarter of an inch from the standard lengths.

13. The causes for a permanent rejection of a rail, as a first class rail, are:
1. A bad test report, showing a deficiency or excess of carbon.
2. The presence of a flaw of one-quarter of an inch in depth in any part of the rail.
3. A greater variation between the rail and splice bar than is allowed in paragraph No. 6.
4. The presence of such other imperfections as may involve a possibility of the rail breaking in the track.

By order of the General Manager,
..... , Chief Engineer.

The subject relative to the quantity of the various elements entering into the manufacture of steel which shall produce the rail calculated to give the most wear, and yet avoid brittleness, is one in which there is a greater divergence of opinion, and the most expressive method of summing up the numerous replies received is, that it appears to be a case wherein "doctors disagree."

The rail over which electric motors are operated through thoroughfares in various cities throughout the country is certainly subject to as much, if not more wear, than that of many of the trunk lines; and as we have patterned mostly after their method of construction, we may perhaps profit by following their example in other details.

In the various forms of the head, the centre bearing rail is the most desirable because, with another tread on each side, the head is kept free from dirt and consequently there is less resistance to the car wheels.

In many localities the use of this form of head is prohibited. This was at a period, however, when cars were operated by animal traction, when at least seventy-five per cent. of all vehicle traffic along streets where cars were run were accustomed to use the track. If there ever was any valid objection from this source, the introduction of rapid transit has certainly overcome it; for drivers of vehicles generally shun the tracks of roads operated by rapid transit.

The public now demand that the quickest possible time be made in transporting them to and from their homes and places of business, and where once the unruly teamster held sway for blocks at a time, ahead of a slow going horse car and patient passengers, he is now compelled by the change of motive power and a strong public sentiment to keep to the right as the law directs and the public demand. Passengers now figure on the exact time required to reach their destination, whereas under the old order of transportation, the street car ride was looked upon as a necessity only, for the convenience it afforded. What is therefore of most service to the railway company is likewise beneficial to the public; and your committee would earnestly recommend that in communities where objection is made to the use of the centre bearing rail that the authorities be asked to give the subject careful consideration, at least for a comparative test. We claim that it does not impede vehicle traffic, nor would it be objected to by owners and drivers of vehicles when properly laid, to the extent of prohibiting its adoption.

Next to the centre bearing form of hed, the side bearing head is by far the most desirable, from the operator's standpoint; for the only other form made, of the girder type, is that with a groove, instead of a lower flange. The latter form of head is suitable only for curves and cross overs, when rolled with a wide groove, and should never be adopted for straight track, owing to the tendency of the groove to hold dirt, snow and ice.

In the selection of a girder rail of any form of head, and more particularly the style known as side bearing, it would be well to remember that the rail having the widest base offers the greatest resistance to turn over; and care should therefore be exercised in the selection of the rail, to secure the widest possible foot. This subject requires no argument to demonstrate its necessity, and your committee, knowing the desire of various manufacturers of rails not only to keep abreast of our wants, but who are constantly employed at large expense in devising new and perfecting existing styles, would urgently advise enlarging the rolls at the base of the rail in order that the same shall at least equal in width the combined width of the tread and lower flange.

Fifth.—Chairs.

The less number of parts about the construction of a roadbed the more economically is it maintained, and the use of a chair, the only purpose of which is to provide for the required height to the top of the rail for paving purposes, is not recommended. It is much better to secure this height by the adoption of a rail having a higher web, thus enabling the rail to be spiked directly to the cross tie by means of a tie plate, which tie plate should be provided with a brace extending upward to the bottom of the outer head of the rail to prevent the rail from turning. Where a plain tie plate is adopted a cast iron brace should be spiked to each tie. No girder rail should be laid without making provision to prevent it from tipping, and the above plan, being more economical than the use of a tie rod, is preferable, as its bearing at the upper portion of the rail is more serviceable in checking the strain than a tie rod secured through the web of rail.

If chairs are required care should be exercised in selecting such as will insure the greatest possible bearing on the tie and such only as will not spring under heavy loads. A chair with a narrow base is apt to cut into the cross tie and in time work loose or cause the rail to cant. All intermediate chairs should be provided with a brace extending well up under the outer head of rail, which is the best safeguard against the rail turning or canting.

Sixth.—Joint Supports.

There are a large number of joint supports now in the market and in use, some of which are offered by the manufacturers of rail, and some devised and manufactured by others, and it would be unfair to dwell on the merits of those of any particular manufacturer; but your committee would very urgently recommend the adoption only of such joint supports as are of sufficient length to cover at least two ties, but we consider such as secure a bearing on three ties preferable. The holes in the web of the rail should be not less than one inch in diameter, to admit the use of a bolt having a large size nut, which should be tightly secured by the use of a hammer and wrench. A six-hole fish plate of sufficient height to reach from the foot of the rail to the bottom of the head, 26 inches or over in length, securely fastened with large size bolts, is considered by many who have used the same to be superior to all other joint fastenings.

We must bear in mind that cars, as now operated by electricity, are not only heavier than horse cars, but are operated at a much higher rate of speed, and require the most thorough construction. The slightest spring, or looseness, will gradually result in a low joint, which if not soon attended to will ruin the end of the rail beyond repair. It would, therefore, be well to relieve the fish plate of much of this strain, by providing a support for the bottom of the rail extending over two or more cross ties.

The rails, when laid in hot weather, may be closely joined, but if laid in low temperature, proper allowance should be made for expansion.

There exists among railway managers a difference of opinion as to the choice between a supported or suspended joint. Your committee, however, earnestly recommends the supported joint, with a support for the bottom of the rail extending to the adjacent ties, and does not deem it advisable to adopt the suspended joint construction, unless the joint support has a firm bearing on the adjacent ties. There are a number of such joint chairs of various manufacture now in use, which your committee are reliably informed are giving entire satisfaction.

There is also a diversity of opinion as to the location of rail joints with respect to each other, and on this subject we do not hesitate to take a firm stand in support of the joints being laid directly opposite each other, when constructed for electric traction, as the tendency where laid with broken joints is to cause the car to sway sideways, particularly at a high rate of speed, if the joints are not kept extremely perfect.

The former plan renders it also more economical to repair joints, especially in paved streets.

Seventh.—Paving.

In the construction of a perfect street railway this item, while it comes last, is by no means least, and in many instances solves the problem of economic management in electric traction; for with unpaved and poorly maintained street it is impossible to build any track that will be entirely non-obstructive, for not only does it impede vehicle traffic, and cause untold annoyances to railway managers and passengers alike, but it also offers a very great resistance to the operation of cars by reason of the constant accumulation of dirt and dust on the rail. It is therefore essential to the property owner fronting on the street, the railway company, and the general public alike, that the street be constructed of the very best known material. Of course paved streets are preferable, not only because they permit of a uniform level with the track, but add largely in holding the latter to gauge, and in protecting it from being constantly cut alongside by vehicles; and being much more free from dust and dirt, it also effects a large saving in current required for the operation of cars.

Of the various kinds of paving now in use the following are chiefly adopted, and about in the order in which they are named: Granite, telford, asphaltum, wood and brick. The former being by far the most durable, cheapest maintained and less expensive to remove and replace, for the necessary track repairs, justifies the adoption of the same over that of asphaltum, wood, or brick, and warrants the additional first cost, which accounts for its almost general adoption by street railway companies where paving is required, and by municipal authorities on streets where railway tracks exist, or are contemplated. In some localities asphaltum paving is adopted on streets where railway tracks are laid; but owing to the tendency of vehicular traffic to wear ruts alongside of the rail and the spring of the rail to loosen the paving material, together with the increased cost of repairing the same, it is not as favorably considered for track paving as some of the other systems. To overcome the first named objection in some localities where this paving is adopted a double row of granite blocks is laid adjoining the rail, which also provides for the vibration of the rail, and renders it more accessible to get at the foundation of the roadbed for necessary repairs.

Telford paving is laid by placing stone, known by quarrymen as rip rap, as close together as the same can be laid, and filling the interstices with macadam, or broken stone, which is laid for a depth of about three inches over the rip-rap, all of which is thoroughly rolled, and covered with a thin coating of sand and gravel. This system of paving, if it can be designated by that name, is, however, not suitable for thoroughfares subjected to heavy vehicular traffic, and should only be adopted for street railway tracks on suburban divisions, where, owing to its cheapness, it is quite extensively adopted.

The first cost of paving a street is always the greatest obstacle to overcome, owing to the necessity of providing a suitable sub-foundation. This once done, the street is maintained in good repair by simply renewing the upper roadway, and on account of its cheapness in some localities, as compared to other paving material, wood is quite extensively employed; but on account of its perishableness caused by wear from heavy vehicular traffic, and decay caused by atmospheric changes, and the further fact that, owing to the expansion of the wood when absorbed with moisture, the blocks bulge upward in places, and in some instances have caused the closing of slots in cable railways, and the breakage of various portions of the running gear of both cable and electric cars, this system is not so generally adopted.

Brick in any form, made of clay or other material, has thus far not stood the test of vehicular traffic to warrant its adoption in any climate, either by railway companies or municipalities, and should, therefore, be given a most thorough trial before it is extensively used.

With girder rail construction it is advisable to fill in the web of the rail with moist clay just before paving, in order to prevent the paving blocks from working loose, caused by the sand surrounding the same, filling up the said space, thus leaving the blocks unprotected, and tending to cause the row of blocks adjacent to the track to settle unevenly. In some localities an iron frame is constructed at each joint for the purpose of providing for repairs to the same without disturbing the paving; but with the latest girder rail joint construction, ties well tamped and bolts securely fastened, the necessity for such construction does not exist.

Eighth.—Underground Wiring.

This subject is one that is usually intrusted to the contractor securing the electrical equipment, and by him sometimes sublet together with the overhead line work. As all this work is underground, out of sight, and with paved streets made inaccessible without incurring large expense to repair and renew, the most practical method of workmanship and material should be adopted.

The object to be accomplished is to form a perfect connection from each rail along the road to the poles of the generator at the power house; the ground wire being connected to the negative poles, and the overhead wire to the positive poles of the machine, although we have read of the reverse being the rule on some lines, but, as the matter is foreign to the subject now under consideration, we will not further digress therefrom.

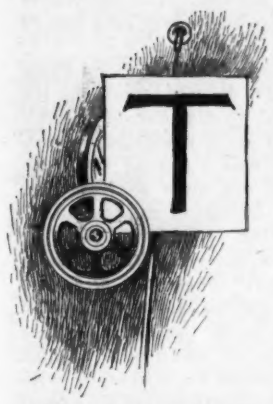
A large size insulated copper wire is generally adopted to form the connection between the generators and such points along the track as it is deemed advisable to reach. The return circuit, for by that name it is known, may be completed, either by connecting said wire to the rail, or to a supplementary wire extending the entire distance of the track. The latter is in all cases recommended, and should invariably be soft copper wire, not smaller in size than No. 0. In either event, however, all rail joints should be bonded with a soft copper wire, not less in size than No. 6, and if the supplementary wire is laid, a connection thereto should be made to at least every fifth rail; and it will also be of great advantage as a safeguard against any possible break in the circuit to connect both sides of the track with a No. 6 wire, and, if a double track, to cross to the opposite track, and to the supplementary wire in said track, at least every thousand feet.

We have heard of instances being cited where copper wire laid underground was more susceptible to electrolysis than that of galvanized iron or steel; but after a thorough trial of upward of three years, during which time we have used both, the conclusion reached is, that copper being not only a better conductor, but less liable to corrode and break, is therefore the best wire to use for underground work. Galvanized soft steel, or iron wire, used for this purpose, has not proved durable, and we have found the same to be entirely eaten away by electrolysis where it had come in contact with the cross tie, and in perfect condition elsewhere. The only theory we can advance for this is, that a chemical action takes place between the gases of the earth, precipitated by the sap contained in the timber and salt water—the latter from the use of salt for the purpose of melting snow and ice, although such results have not been noticeable in the use of copper wire. In addition to cross wiring, as above mentioned, as a precautionary matter, to insure a complete circuit, it will be found advantageous to the economical operation of an electrical railway to excavate or bore in the earth to a sufficient depth to secure continual moisture, and while iron is usually adopted, owing to its cheapness, yet we believe the use of copper will, in time, prove the most economical metal to adopt for this purpose—for we beg leave to repeat: "The best is none too good." Where such grounds are located, care should be taken to make the best possible connection to the supplementary wire and the track.

By a careful examination of the ampère meter at the power house, during dry weather, compared with that of rainy weather, it will be noticed that there is a marked decrease in the amount of current used, in favor of the latter; hence it follows that the more connections to the rail and the opposite poles to the generator, with the moist earth, the more economically is the system operated. It must also be remembered that the increased saving in current in wet weather, over that of dry weather, is not attributable to the increased moisture of the earth alone, but to the fact that the dust and dirt, which readily find lodgment on the rail, are washed off; and many roads now in operation by electricity have found the use of a car equipped with a tank having one down spout, about ⅝ inch in diameter on each side, so arranged as to permit a stream to flow over the head of each rail, most advantageous. These down spouts should be located as near the wheel as possible in order to insure the same being directly over the rails at all curves as well as the straight track.

In conclusion we have only to say, as to the construction of a model electric street railway roadbed and underground wiring, its successful accomplishment will involve the comparison and investigation of a wide range of personal experiences, coupled with the patient study of those engaged in the manufacture of rail and track supplies, who are constantly endeavoring at great expense to improve the material and method of construction.

Cleveland Convention Notes.



THE General Electric Company in its exhibition this year surpassed all previous ones which the Edison and Thomson Houston companies ever made. It is now able to show what is best in both systems. The exhibition was in every way worthy of so large, prosperous and energetic a corporation. The arrangement of the exhibit permitted an examination of the company's entire railway system without any exertion on the part of the visitor. On a Brill truck, two "W. P. 30" single reduction railway motors were mounted, showing their lightness, general compactness and ease of adaptation. The "W. P. 50" motor, with its field coil thrown back, permitted an examination of the interior parts. The "S. R. F. 30" motor—a modification of the old "F. 30"—was arranged next to this, and is described in detail elsewhere in our pages. Next to this the standard S. R. G. railway motor was shown. An Edison No. 14 motor was mounted in the centre of the exhibit. A gear press for applying and removing gear wheel from motors was also shown.

The series parallel controller, from which any objectionable features which were found in those first made are said to have been eliminated, was exhibited. One of the particular features of the exhibition was the overhead parts, some of which we illustrate. They were arranged on a long sloping board which showed them off to considerable advantage. In order to render them still more conspicuous, they have been carefully plated and polished. For the design of this apparatus as well as for its arrangement on the board, credit is due to Mr. Elmer P. Morris. The station switchboard, equipped with automatic circuit breaker and current indicator of the latest and most improved type, and a board on which were mounted several of the Thomson wattmeters for railway circuits, were prominent and attractive parts of the exhibit. The General Electric Company ran two cars over the East Cleveland Company's lines: one, a special vestibule car upholstered in deep brown plush, and furnished with easy chairs. This was mounted upon a single truck, equipped with two "W. P. 30" motors. The other car was a giant, 40 feet long with double trucks, each equipped with a "W. P. 50" motor. The floor of this was removable so that the operation of the apparatus could be seen. Recording instruments to show how much energy was required to operate the cars were used. The headquarters of the company at the Hollenden Hotel were tastefully decorated with green shrubs, ferns, plants and flowers, and hung with photographs. Mr. W. J. Clarke, the general agent of the Railway Department, in whose hands the entire management of the General Electric Company's exhibit was placed, acted as "host." Mr. Clarke was ably seconded in his efforts by Mr. Elmer P. Morris, of the Railway Supply Department; Mr. G. K. Wheeler, assistant manager of the Chicago Railway Department; Mr. F. J. Clarke, manager at Washington; Mr. H. H. Harrison, Mr. C. S. Rusling, Mr. I. Silverman, W. A. Stern and a thoroughly competent staff of the General Electric Company's men as follows:

O. T. Crosby, Gen. Mgr. Ry. Dept., Boston, Mass.; W. J. Clark, Gen. Agt. Ry. Dept., New York; G. K. Wheeler, Asst. Mgr. Ry. Dept., Chicago, Ill.; Paul T. Brady, Gen. Mgr. Central T.-H. Co., Cincinnati, O.; F. H. Clark, Gen. Mgr. Gen. Elec. Co., Washington, D. C.; C. S. Rusling, Gen. Mgr. Ry. Dept., Cincinnati, O.; W. H. Knight, Chief Eng. Ry. Dept., Boston, Mass.; E. W. Rice, Supt., Lynn, Mass.; Theo. Stebbins, Supt. Con. Ry. Dept., Boston, Mass.; E. P. Morris, Mgr. Ry. Supt. Dept., Boston, Mass.; Arthur W. Jones, Asst. Mgr. T.-H. Internat. Co., New York; A. A. Glazier, Mgr. Indust'l Improvement Co., Boston, Mass.; Caryl D. Haskins, Mgr. Meter Dept., Boston, Mass.; John McGhie, Mgr. Advert'g Dept., New York; Geo. W. Mansfield, Spec. Agt., Boston, Mass.; E. G. Waters, Gen. Mgr., Pittsburgh, Pa.; W. A. Stern, Mgr. Ry. Dept., Philadelphia, Pa.; H. H. Harrison, Supply Dept., New York; C. E. Hart, Supply Agt., Cincinnati, O.; A. H. Lewis, Spec. Agt. Ry. Dept., New York; T. H. Fearey, State Agt., Syracuse, N. Y.; R. J. Randolph, Special Agt., Cincinnati, O.; F. H. Strieby, Supt. Con., Cincinnati, O.; C. T. Hamilton, Special Agt., Pittsburgh, Pa.; F. E. Jackson, Representative Lamp Dept.; F. E. Allen, Agt., St. Louis, Mo.; S. P. Wells, Agt., St. Paul, Minn.; C. R. Stern, Supt. Con., St. Paul, Minn; Percy Hodges, Mgr. Shipping Dept., Boston, Mass.; T. F. Mullaney, Elec. Eng., Boston, Mass.; M. H. Hamilton, Private Sec'y., New York; J. A. Kimball, Elec. Engr., Boston, Mass.; W. S. Elliott, Agt. Ry. Dept., Chicago, Ill.; Mr. Ewing, Agt. Snow Sweeper Dept., Boston, Mass.; F. H. Bostwick, Agt., Cleveland, O.; B. M. Barr, Agt., Cleveland, O.; F. Houghton, Agt., Cleveland, O.; G. H. Stout, Agt., Cincinnati, O.; E. P. Sharp, Elec. Engr., Boston, Mass; W. B. Potter, Elec. Engr., Boston, Mass.; G. H. Alton, Supt. Meter Dept., Boston, Mass.; Mr. Woolsey, Elec. Engr., Boston, Mass.; R. E. Hood, Elec. Engr., Boston, Mass.; Geo. M. Haskell, Elec. Engr., Boston, Mass.; F. J. Reynolds, Ry. Expert, Cincinnati, O.

The Short Electric Railway Company embraced the excellent opportunity which it had of exhibiting not only its finished products but all of its apparatus in the process of manufacture at its extensive factory in Cleveland. On Wednesday afternoon a very large party of the delegates were taken by special cars furnished by the Short company to the company's works, where lunch was served and opportunity given for the inspection of the shop and its equipment. The best section of Army and Navy Hall was given up to the Short company's exhibit. Here was shown the process of winding an armature for the new Short gearless motor. Four motors were shown to exhibit the evolution of the present type of gearless motor. Two specimens of single reduction motors of different capacities were shown, as were also the single reduction and the new gearless, partially dissected in order to show the internal construction. A 50-inch commutator for a new railway generator attracted a good deal of attention. Switchboard instruments, commutators, and various parts formed a portion of the exhibit. Ball bearings used on the Short generators and motors, together with the brush holders and rockers, were shown, detached from their machines. There was scarcely any part of the railway motor that was not shown in various styles, including the shell used for the magnets, partially wound armatures, gears, switches, trolley stands and magnet cores. In addition to the exhibit made in the hall, the company occupied two of the best parlors at the Hollenden, where representatives of the company exhibited photographs and drawings of railway apparatus, and described in detail its construction to street railway men. A number of street cars running on the various lines of the city equipped with Short motors were placed at the disposal of the delegates by the construction of a temporary track on the vacant street at the rear of the hotel, where the cars were side tracked to make special trips whenever the delegates desired to have them do so.

One of the most elaborate and extended exhibits made was that of the Westinghouse company. In addition to the headquarters of the company, in one of the finest and most easily accessible of the hotel parlors, where a number of representatives of the company exhibited photographs and blue prints of the company's apparatus, about one-fourth of the floor space of Army and Navy Hall was occupied by an exhibit of railway motors and appliances of the very latest type. A car truck, manufactured by Dorner & Dutton, of Cleveland, O., was equipped with two Westinghouse motors in such a way that it could be shown in operation whenever desired. A generator of 150 h. p. capacity of the Westinghouse multipolar type was shown in operation. It was driven, however, not by a belt, but as an electric motor. Non-arcing lightning arresters, of the Wurts type, Keystone lightning arresters, brush holders, commutators, detached armature coils, a series parallel car controller, various types of gears, specimens of stamped armature discs, lamp fittings and various types of street car motors were shown and described to the visitors by the company's representatives. One of the principal features of the exhibit was a handome switchboard, on which were mounted railroad ammeters and voltmeters with automatic lightning arresters and circuit breakers. Any quantity of literature that the delegates might ask for in regard to Westinghouse apparatus and its operation was distributed from the company's headquarters, and a number of cars equipped with Westinghouse apparatus were on exhibition on one of the railway lines of the city.

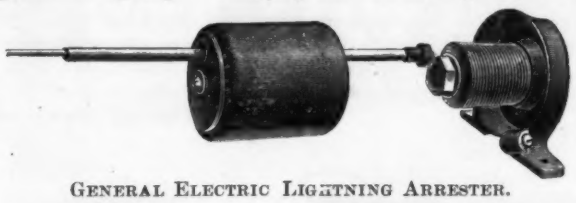
The Ford-Washburn Storelectro Company was represented by Jas. Chamberlain, Percy Warwick and Fred Hild, the duty of hosts taking up the greater part of the time of Capt. Ford and Mr. Washburn; 1½, 2 and 5 h. p. 500-volt motors of the well-known type of this company were on exhibition, and a 12-inch fan motor driven by two cells of its storage batteries. The exhibition of the remarkable properties of its storage cells attracted great attention. A 9-inch × 8½-inch × 5¼-inch cell was being constantly short-circuited through a 400 ampère meter, the pointer of which brought up with considerable force against the stop, showing that the discharge was considerably greater than 400 ampères. A smaller cell was employed in fusing No. 12 wire, and in both cases the cells seemed absolutely unaffected by the abnormal currents. The Washburn & Moen Company used these cells to show the properties of its Salamander wire, fusing the wires or heating them to a white heat. The Metropolitan Street Railway Company of Washington has ordered some of these cells for its storage battery cars. An exhibition was also given of the Ford-Washburn storage battery car.

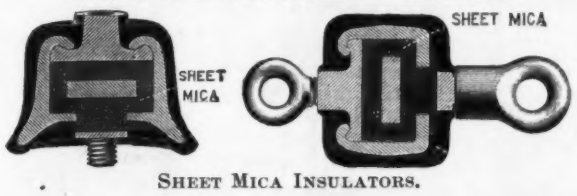
W. E. Irish, of Cleveland, exhibited in the Society for Savings Bank Building a model of his recently invented electric railway conduit system and arc lamps equipped with his very ingenious thermal regulators. There are no magnets or solenoids, regulation being effected by the contraction or expansion of a strip of metal, through which about 80 per cent. of the current of the lamp passes. As the arc becomes longer from the burning of the carbons, the decreased current heats the metal less, which contracts and permits the carbon to slide down, or *vice versa*. The regulating clutch is constructed on a differential principle, is very simple in construction, and enables the lamp to furnish an absolutely steady light. The mechanism is equally applicable to continuous or alternating currents, and greatly reduces the "singing" when used with the latter. Mr. Irish also showed a hot wire ammeter of his invention and several other ingenious devices.

The Brightman mechanical stoker, was shown and attracted considerable attention. Several sales were reported. The fuel in the hopper in front of the boiler is gradually fed to the grate bars by a "pusher," which is adjustable to any rate of feed. The grate bars are inclined at an angle of 34 degees, to the horizontal, and are alternately fixed and movable. The movable bars have a reciprocating motion, which is adjustable, and gradually move the fuel toward the end of the furnace, at the same time preventing the formation of clinkers and keeping the fire in good condition. The clinkers, ashes and some unconsumed coal finally fall into the pit from the extremities of the back bars. The economy of a self-feeding furnace is so obvious that we do not hesitate to predict a bright future for this ingenious device, which is manufactured by the Brightman Stoker Company, Cleveland. The exhibit was in charge of G. B. Herndon and G. C. Shepard.

The Johnson Electric Company, manufacturers of electric railway supplies, of Cleveland, O., made a very interesting exhibit of goods of its own manufacture. This company has been in the field only a short time, and yet the exhibit made was an excellent one. The proprietors of the concern are Albert L. Johnson, of Cleveland, and Samuel Harris, who is connected with one of the street railways of Cleveland. Among the apparatus exhibited may be mentioned bearings and commutators, the Johnson trolley base, shown in one of the accompanying illustrations; motor gears of all sorts for every type of motor, commutator seg-

WESTINGHOUSE HEADQUARTERS.

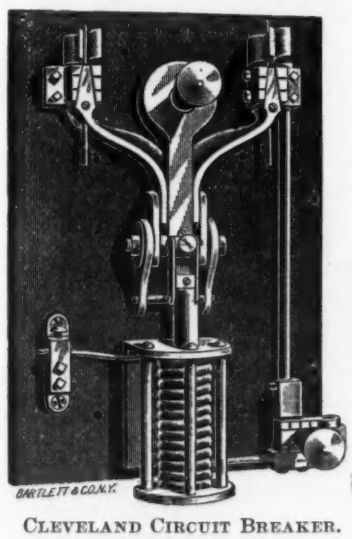

GENERAL ELECTRIC LIGHTNING ARRESTER.

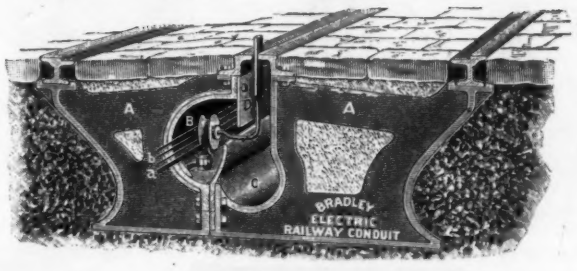


SHEET MICA INSULATORS.

S. R. G. MOTOR.

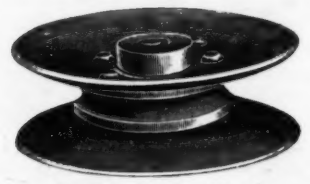
GENERAL ELECTRIC MONOGRAM.

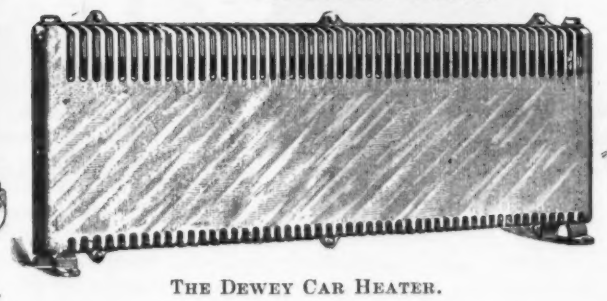

CLEVELAND CIRCUIT BREAKER.



THE BRADLEY CONDUIT.

"GLOWING GRAPES."


THE JOHNSON WHEEL.


THE DEWEY CAR HEATER.

THE BRILL EXHIBIT.

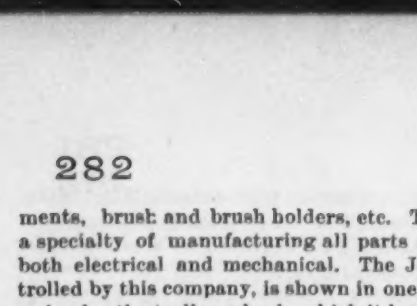
THE JOHNSON TROLLEY.

ments, brush and brush holders, etc. The company makes a specialty of manufacturing all parts of electric motors, both electrical and mechanical. The Johnson trolley, controlled by this company, is shown in one of the illustrations, as is also the trolley wheels which it handles.

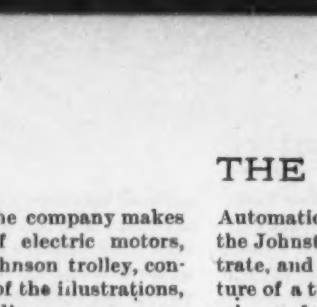
The Sperry Electric Railway Company was represented by Elmer A. Sperry, H. P. Barr, general manager, and C. A. Pratt, and had on view an extensive exhibit. There was shown in operation a 40-h. p. motor on a truck with the new cushioned universal clutch, besides a complete car and a beautifully finished model motor and truck. In this late system the motor is substantially supported and flexibly connected to the wheels, objectionable rigidity being thus avoided. Other features of the exhibit were a controller and rheostat, with bellows to blow out a spark and a magazine fuse and lightning arrester with four fuses that can be used in succession. In addition there was a line of commutators, motor bearings and parts, a switchboard fitted with station apparatus, trolley, etc. A commutator spring was shown to take up expansion and contraction in commutators.

The extensive exhibits prepared by the Electrical Supply Company, of Chicago, failed to arrive through a mistake in shipping, but Mr. M. M. Wood supplied the deficiency as far as possible with his traveling samples, consisting of a well designed series of overhead material and small types of the well-known Carpenter electric heater. A handsome souvenir catalogue was distributed in which a very clever greeting introduced in an unusually *apropos* manner the names of the founders of the Street Railway Association, "A sturdy stock that has grown and flourished from the *Littell Rugg*-ed *Bean* thus planted under the *Lowry*-ing clouds of that gray December day."

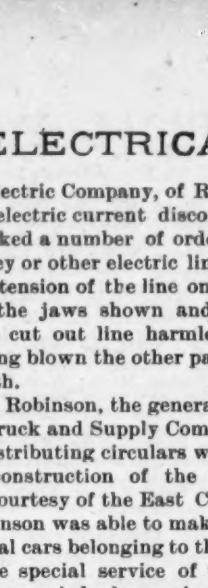
The J. G. Brill Company, of Philadelphia, was at the Convention in force, both in *personnel* and *material*. The president, Mr. J. M. Brill, was ably assisted by Messrs. Hewlings, Curwen, Randall and Andrews, Parlor A of the Hollenden being headquarters. Besides four cars recently supplied to the Cleveland Railway Company, the visitor had an opportunity to examine a handsome car in front of the annex,



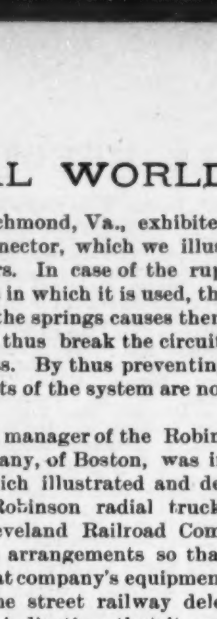
A WELL-KNOWN TRADE MARK.



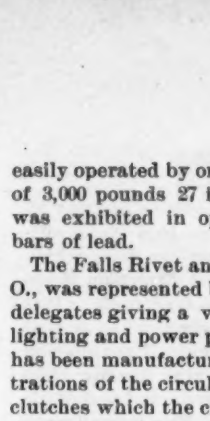
NEW PROCESS RAWHIDE



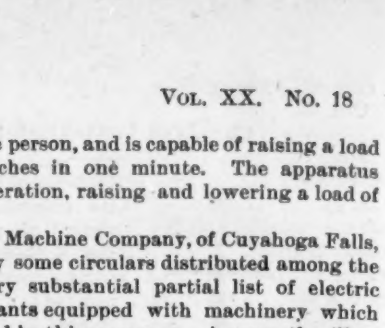
"SALAMANDER."



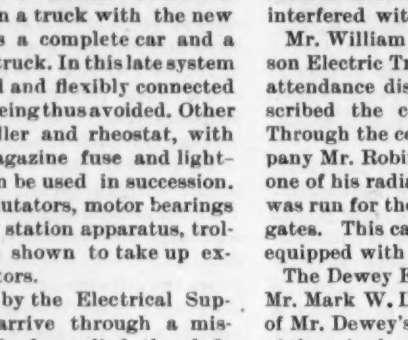
DEWEY HEATER.



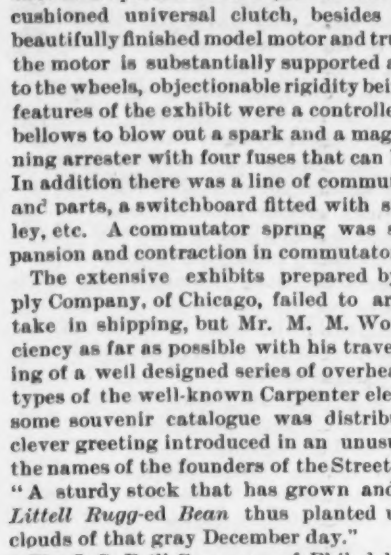
COMMUTATORS OF THE ELLIOTT ELECTRIC CO.



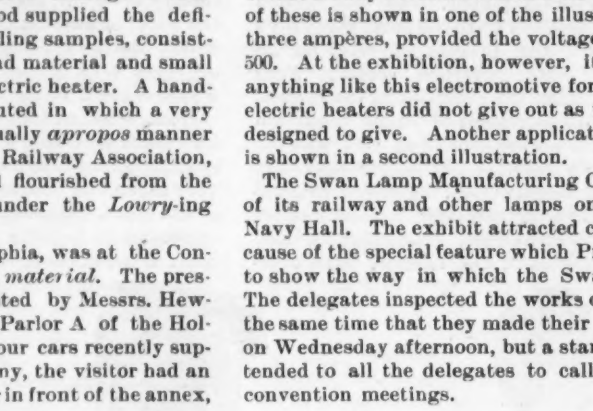
EHHIBIT OF RELIANCE GAUGES.



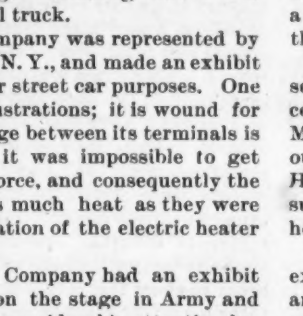
H. W. JOHNS CO. INSULATOR.



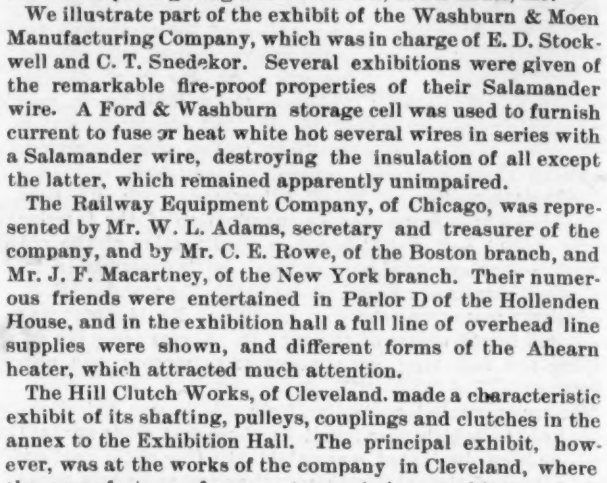
EDISON VOLTMETER.



THE TAYLOR TRUCK.



"HATCHING" SWAN LAMPS.



THE GENETT AIR BRAKE.

a No. 21 Brill truck and a maximum traction truck, while handsome models of all trucks were on exhibition in the hall. A new feature in all of these trucks is the solid forged axle box frame which has given the fine results to be expected from such a construction.

The Cleveland Automatic Circuit Breaker for railway generators was shown by Mr. W. B. Cleveland, its inventor, for the Forest City Electric Works, of Geneva, Ohio. Three of these circuit breakers were mounted upon a very handsome board and over each one was placed a new type of ammeter, which Mr. Cleveland has just brought out. The circuit breaker, which is shown in one of the accompanying illustrations, is intended to replace the fuse wire on the switchboard, and one of the principal features is the wedged contacts for carrying the current. These switches are made in different sizes ranging from 100 to 300 ampères carrying capacity.

The only underground conduit exhibited was that of the Bradley General Electric Company, of 119-121 La Salle street, Chicago, Ill. This company was represented by Mr. H. C. Hartman. A view of the conduit is shown in one of the accompanying illustrations. A full sized model of the conduit was shown and attracted a great deal of interest. Its construction is somewhat similar to that of the cable conduit in use in Chicago. The working conductor is carried in one side of the conduit, the bottom of the channel in this part being several inches above the bottom of the channel in the other half, which is connected with the sewer for drainage purposes.

Sidney H. Wheelhouse, of the Star Headlight Company, of Rochester, N. Y., exhibited a street car headlight, the invention of Mr. Wm. M. Sturges, superintendent of the Utica Belt Line Railroad Company, which attracted much attention. It consists of a regular Star headlight with the addition of two 5-inch semaphore lenses, by means of which, by the combination of different colored glasses, 15 combinations can be made to show the direction of the car or indicate the line. The change from one combination to another can be made in a few seconds, and where electric lamps are used the lights are changed by one switch for the return trip.

F. B. Jenkins, secretary and treasurer, and W. A. Cutler, superintendent of line construction, of the Johnston Safe Automatic Electric Company, of Richmond, Va., exhibited the Johnston electric current disconnector, which we illustrate, and booked a number of orders. In case of the rupture of a trolley or other electric line in which it is used, the release of the tension of the line on the springs causes them to throw out the jaws shown and thus break the circuit, rendering the cut out line harmless. By thus preventing fuses from being blown the other parts of the system are not interfered with.

Mr. William Robinson, the general manager of the Robinson Electric Truck and Supply Company, of Boston, was in attendance distributing circulars which illustrated and described the construction of the Robinson radial truck. Through the courtesy of the East Cleveland Railroad Company Mr. Robinson was able to make arrangements so that one of his radial cars belonging to that company's equipment was run for the special service of the street railway delegates. This car carried a large sign indicating that it was equipped with the Robinson radial truck.

The Dewey Electric Heating Company was represented by Mr. Mark W. Dewey, of Syracuse, N. Y., and made an exhibit of Mr. Dewey's electric heaters for street car purposes. One of these is shown in one of the illustrations; it is wound for three ampères, provided the voltage between its terminals is 500. At the exhibition, however, it was impossible to get anything like this electromotive force, and consequently the electric heaters did not give out as much heat as they were designed to give. Another application of the electric heater is shown in a second illustration.

The Swan Lamp Manufacturing Company had an exhibit of its railway and other lamps on the stage in Army and Navy Hall. The exhibit attracted considerable attention because of the special feature which Prof. Roberts had designed to show the way in which the Swan lamps were hatched. The delegates inspected the works of the lamp company at the same time that they made their trip to the Short factory on Wednesday afternoon, but a standing invitation was extended to all the delegates to call at any time during the convention meetings.

The Fulton Foundry Company, of Cleveland, represented by W. E. Haycock and C. J. Langdon, had a large exhibit of electric car appurtenances, including several trucks, double tread wheels with independent brake rims, Robertson's patent drawbars, patent shoes and independent slippers, Lyons patent motor brush holder, and many other car fittings. A feature of the exhibit was a wrecking truck, by means of which a wrecked motor truck can be kept clear of the track and the car driven by the other motor to the motor house.

One of the most attractive features of the entire exhibition was the display of overhead fittings by the General Electric Company. These were designed by Elmer P. Morris and were arranged for the exhibition under his direction. Two of these fittings are shown in the accompanying illustrations —one of these is the span strain wire insulators and the other shows the new style of sheet mica insulator made in the form of a bell. The sectional illustrations show very clearly the construction, so that no detailed description is necessary.

The exhibit of the Peckham Motor Truck and Wheel Company, of Kingston, N. Y., comprised a No. 5 truck, specimens of rigid and interchangeable wheels and interchangeable axle, a sample of the Peckham radial gear and journal box, and other apparatus. The company was represented by Mr. E. Peckham, Mr. E. C. Stark, traveling agent, who was on his way to Portland, Ore., Mr. E. S. Bemis, Jr., who went to Chicago immediately after the convention, to establish a branch office, and Mr. A. W. Field, of New York City.

Mr. E. M. Smiles, representing the Edison Manufacturing Company, exhibited the new Edison electrostatic voltmeter, which we illustrate. This is a remarkably simple instrument, which is entirely unaffected by the proximity to iron or magnetism, and, once calibrated, is always accurate. It consists of a suspended vane, connected to one side of a circuit, and a surrounding metallic core connected to the other side, the electrostatic attraction between these two fixing the position of an aluminium pointer.

The Cleveland Motor Lift Company had an exhibit that attracted considerable attention in the shape of a hydraulic lift for raising and lowering electric motors to and from their position under a car. This lift is shown in one of the accompanying illustrations. It is simple in construction, easily operated by one person, and is capable of raising a load of 3,000 pounds 27 inches in one minute. The apparatus was exhibited in operation, raising and lowering a load of bars of lead.

The Falls Rivet and Machine Company, of Cuyahoga Falls, O., was represented by some circulars distributed among the delegates giving a very substantial partial list of electric lighting and power plants equipped with machinery which has been manufactured by this company. Among the illustrations of the circular is a view of the huge shafting and clutches which the company has in operation in the plant of the Municipal Lighting and Power Co., of St. Louis, Mo.

We illustrate part of the exhibit of the Washburn & Moen Manufacturing Company, which was in charge of E. D. Stockwell and C. T. Snedekor. Several exhibitions were given of the remarkable fire-proof properties of their Salamander wire. A Ford & Washburn storage cell was used to furnish current to fuse or heat white hot several wires in series with a Salamander wire, destroying the insulation of all except the latter, which remained apparently unimpaired.

The Railway Equipment Company, of Chicago, was represented by Mr. W. L. Adams, secretary and treasurer of the company, and by Mr. C. E. Rowe, of the Boston branch, and Mr. J. F. Macartney, of the New York branch. Their numerous friends were entertained in Parlor D of the Hollenden House, and in the exhibition hall a full line of overhead line supplies were shown, and different forms of the Ahearn heater, which attracted much attention.

The Hill Clutch Works, of Cleveland, made a characteristic exhibit of its shafting, pulleys, couplings and clutches in the annex to the Exhibition Hall. The principal exhibit, however, was at the works of the company in Cleveland, where the manufacture of power transmission machinery of al kinds, including friction clutch pulleys, cut-off couplings, plain cast iron boilers, self-oiling adjustable bearings, hangers, etc., could be inspected in detail.

The R. D. Nuttall Co., of Allegheny, was represented by C. J. Mayer and W. C. Groetzinger, and P. H. Carey, of the Chicago branch, and a large exhibit of street railway supplies. Besides their well known trolley, special alloy bearings and dermaglutine pinions, their exhibit comprised cast iron and steel gears, commutators, steel trolley poles, a general line of overhead line fixtures, an automatic rail drill and a line of repair parts for motors.

The exhibit made by the W. D. Graves Electrical and Manufacturing Company, of Cleveland, was a very practical one, being an installation of its arc lamps in use for lighting the halls and grounds of the convention, supplied from the same circuits that furnished current for the railway apparatus. These lamps are made for use on 500-volt railway circuits as well as for use on other systems of circuits, both arc and incandescent.

The Genett Air Brake for electric and cable street railways was in active operation on a truck shown in the exhibit of the General Electric Company. A plan view of this truck is shown in one of the illustrations; this cut shows the arrangement of the brake on a single four-wheel truck for an electric car. The compressor is placed on the centre board of the truck and the eccentric on the axle between the motor and the hub of the wheel.

The merits of the Hamilton-Corliss engine, manufactured at Hamilton, O., by the Hoover, Owen, Rentschler Company, were set forth in some well illustrated pamphlets circulated among the visiting street railway men. A neat little souvenir was presented to the delegates by this company. The book was of vest pocket size and contained full details regarding the meetings of the association and its organization.

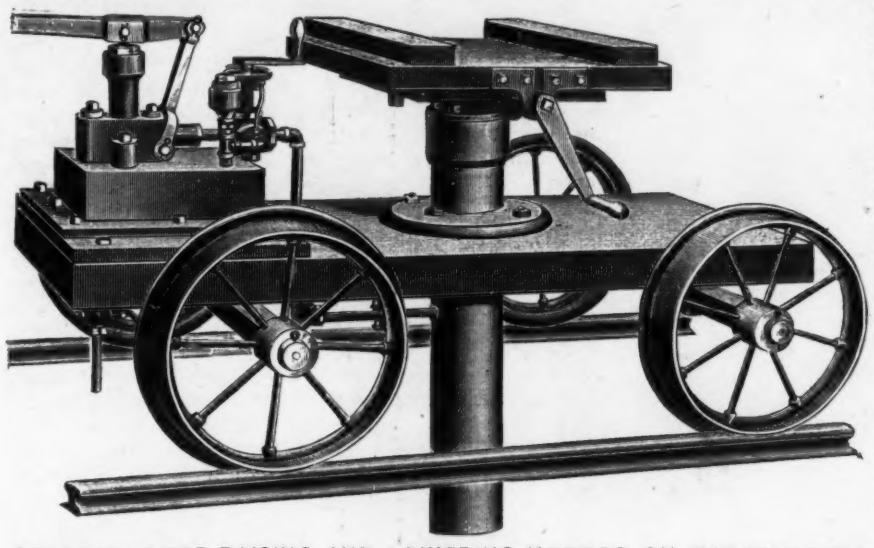
Mr. Frank B. Rae, of Detroit, attended the exhibition in his capacity of consulting engineer, and was warmly congratulated by his many friends upon his success in his new venture. Mr. Rae has been retained by the Park Commissioners of Detroit, as engineer of a new park being laid out on Belle Isle, and we hope to describe in a future issue some of the novel electrical features that will be introduced.

The Supply Manufacturing Company, of Pittsburgh, Pa., displayed some very fine commutators made of Eureka tempered copper. This company is making a specialty of this class of goods, but also deals in electric railway, light and power supplies of miscellaneous character. The company was represented by Mr. Geo. R. Stewart, president; R. R. Hammond, vice-president; and W. Watts, secretary and treasurer.

The Pittsburgh Trolley Company was represented by Mr. A. P. Manning, who was formerly with the R. D. Nuttall Company. Mr. Manning exhibited and explained the merits of the Duncan trolley and trolley wheel with its self-oiling bearing. This trolley has a tapered steel pole made entirely in one piece, and is already well known to street railway men as the compression spring trolley.

The Union Street Railway Supply Company, of Mansfield, Mass., of which Mr. M. Rounds is the general manager and Mr. S. J. Peters, treasurer, was represented at the convention, although no exhibit was made. This company makes a specialty of electric snow plows and transfer tables and trucks, and at the present time has a number of these in operation on different street railways.

The New Process Raw Hide Company, whose exhibit we illustrate, was represented by T. W. Meachem, president; A. C. Vosburgh, secretary, and J. C. Kenyon, treasurer. The many visitors to this exhibit examined with interest a



APPARATUS FOR RAISING AND LOWERING MOTORS ON RAILWAY CARS.

New Process raw hide pinion that had been run over 20,000 miles on a Sprague motor of the West End Railway Company, of Boston.

The Philadelphia trolley, which was described in the last issue of THE ELECTRICAL WORLD, was exhibited by the Technic Electrical Works, of Philadelphia. This concern was represented by Mr. A. L. Register, who distributed some literature explaining the simplicity of the construction of the Philadelphia trolley and also explained its merits to street railway men.

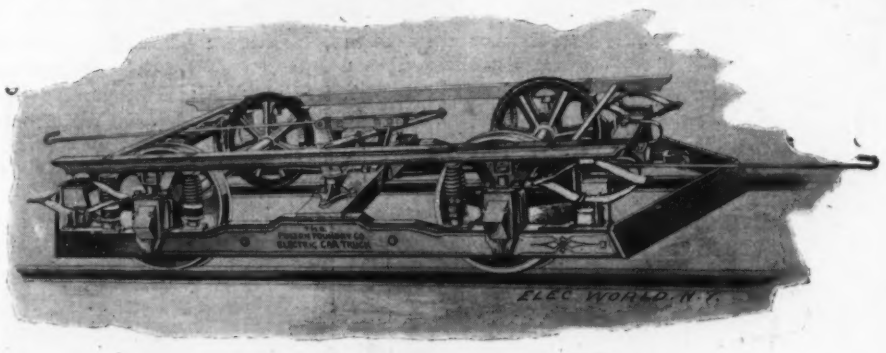
The A. B. C. Company was one of the unfortunates whose exhibits failed to make connections—all except a handsome display board of lamps. Mr. H. G. Issertel, the manager of the railway department, was especially despondent over the non-arrival of a handsome souvenir, but was busily engaged in taking addresses to which to forward it when found.

A souvenir of the convention was given away at the rooms of the General Electric Company. It was neatly bound in flexible covers and contained a great deal of practical information for the street railway man on the management and operation of street railways. A number of extracts were given from Crosby and Bell's book on electric railways.

The H. W. Johns Manufacturing Company was represented by W. F. D. Crane and F. E. Delano with a line of their molded mica and vulcabeston street railway line material, brush fittings, magnet frames, waterproof lamp sockets, etc. The latter are in competition with the usual porcelain shell filled type and attracted considerable attention.

Mr. P. H. Hover, of Chicago, represented the Standard Paint Company, of New York, and took every occasion to explain to as many as possible of the 600 visitors at the Convention the merits of the Standard paint and gave each delegate an opportunity of testing for himself the quality of the now well known Standard Paint convention cigar.

The Reliance Gauge Company, of Cleveland, New York and Chicago, was represented by A. J. Wright and J. H. Elliot and an extensive exhibit of their celebrated safety water columns and attachments, which we illustrate. In case of low water in boilers a solderless copper float in the columns opens the valve of an alarm whistle.



THE NEW FULTON FOUNDRY TRUCK.

The Barnes Brake Company, of Cleveland, O., exhibited an automatic brake for electric cars and was represented at the convention by Mr. D. W. Johns, president of the company; D. J. Johns, vice-president; W. W. Williams, treasurer, and John A. Davies, general manager, as well as by F. H. Davies, one of the company's agents.

W. F. Gurley, of the well known firm of W. & L. E. Gurley, of Troy, exhibited a model of the Taylor electric truck, of which they have undertaken the manufacture—a sufficient guarantee that it contains merit, and will be manufactured with the conscientious care that has given this house a world-wide reputation in other lines.

The Eureka Tempered Copper Company, of Northeast, Pa., had its usual exhibit of samples of goods made from tempered copper. These included commutator bars, brushes, bearings, etc. Mr. J. R. Coffmann was in charge of the exhibit and on the first day of the convention took an order for 25 commutators to be shipped to Montana.

The Skinner Engine Company, of Erie, Pa., although not making any direct exhibit of its engines, was represented at the convention and the interests of the company were cared for by P. L. Sword & Son, managers of the Cincinnati branch office of that company. Circulars and pamphlets describing the engines were circulated.

Silicon-bronze trolley wire for electric railways, as manufactured by the Aluminium Brass and Bronze Company, was represented by Mr. Gilbert M. Smith, the Chicago agent, who circulated some neat little pamphlets giving testimonials from railroad managers who use this wire for overhead lines.

Mr. John R. Coffman, late of the Detroit Electrical Works, besides energetically attending to the interests of the Eureka Tempered Copper Company, found time to show a brush holder of his invention that possesses the valuable property of always maintaining a uniform pressure on the carbon brush.

D. J. Hauss exhibited and described, through some circulars distributed among the visitors at the exhibition hall, a number of electrical appliances which he is manufacturing at his establishment in Cincinnati, O. Among these are switches, line connectors, arc lamp carbon holders, etc.

The Esmond Street Rail Company, of New York, made an exhibit of various styles of rails as well as models of street car trucks. Some little pamphlets giving reports of mechanical and electrical engineers on the Esmond street rail were also distributed by the company's representatives.

Mr. Max Luhn, the electrical engineer of the Helios Co. of Germany, who is in this country making a tour of inspection of electrical appliances and apparatus, spent two or three days at the convention. He expected to sail for Germany immediately on his return from Cleveland.

Mr. Chas. H. Smith, of the C. & B. Manufacturing Company, Broadway, New York, exhibited a trolley finder that will be welcomed by all who ride on electric cars. By means of it the trolley wire can be at once regained and the lights in the car maintained during the time it is off.

S. B. Condit, representing the Shawmut Fuse Wire Company, explained the merits of the Shawmut fuse wire and street railway fuse links and ribbons, all of which are accompanied with certificates of tests, thus insuring certainty in regard to proper protection from overloads.

The Weston automatic engines, manufactured by the Weston Engine Company, of Painted Post, N. Y., were represented by some circulars intended to remind street railway managers that these engines were not to be overlooked when a station equipment was being selected.

The Walker Manufacturing Co., of Cleveland, extended a cordial invitation to those in attendance on the convention to visit its works on Friday morning, and for this purpose provided carriages, which left the Hollenden at 10 A. M. Lunch was served at the company's works.

The Toledo Electric Heater Co., represented by C. S. Jones, vice-president, were unfortunate in finding the space assigned to them appropriated by others, but their unfavorable position did not prevent visitors from taking an interest in the Toledo heater.

The American District Steam Company distributed literature setting forth the merits of the Holly system of direct and exhaust steam distribution in cities and villages for heating and power purposes. The office of this company is at Lockport, N. Y.

J. O. Haddox, of Louisville, Ky., exhibited a track cleaner for which he claimed great durability and simplicity in construction. The claim was also made that it was the only cleaner which is operated by the foot of the motor man on electric cars.

The Western Electric Company, of Chicago, had a very effective display of large reels of wire, which had been sent to Cleveland for use on the Woodward Avenue and West End Street Railway, and which had been temporarily placed on exhibition.

The Crossley Car Brake Company, of 13 South Water street, Cleveland, was represented by Mr. H. C. Crossley and made an exhibit of the company's friction car brake for use on electric as well as on other varieties of street cars.

The Stilwell & Bierce Manufacturing Co., of Dayton, O., distributed pamphlets and circulars giving detailed descriptions of the special machinery which it manufactures for heating and purifying feed water for steam boilers.

The United Tramway Sprinkler Company, of Louisville, Ky., was represented by a little pamphlet giving illustrations and descriptions of the company's sprinkler and testimonials furnished by those who have used them.

The Campbell & Zell Company's exhibit consisted of a model of its improved water tube boiler, for which the claim is made that it is the only boiler that has never caused loss of life, personal injury or destruction to property.

A fine exhibit was made by the Billings & Spencer Co., of Hartford, Conn., showing the Billings patent commutators bars, drop forged of Tobin bronze or pure lake copper. The company was represented by Frank Billings.

The Cleveland Electrical Manufacturing Company was represented by a large staff, with A. B. Foster in charge, and had an exhibit of its fine American watchman time detectors, which are known the world over.

Mr. A. L. Daniels, well known as the "tempered copper man," representing the Mitchell-Brant Copper Company was on hand with a fine display of commutator bars, brushes, bearings, etc., made of tempered copper.

The Cleveland Electric Club had notices posted about the Exhibition Hall informing delegates that they were cordially invited to visit the club rooms and make themselves at home during the session of the convention.

The Jewell Belting Co., of Hartford, was represented by C. E. Newton, C. L. Tolles and G. W. Bancroft, and exhibited several of its belts, one of which, 48 inches wide, was sold to the General Electric Company.

C. S. Van Nuis was on hand as usual with a private exhibit of his Fulmen arresters, and plenty of information as to the merits of these goods, as well as his Ajax switches and other apparatus.

The Standard Tool Company, of Cleveland, Mr. W. W. Johnston in charge, had a large board handsomely fitted up with samples of the fine tools made by them, including pliers, wire gauges, etc.

The Brownell Car Co., of St. Louis, F. B. Brownell in charge, exhibited a handsome accelerator car on the track and a non-oscillating truck and patent trolley bridge in the annex.

The Chapman Valve Manufacturing Company, of Indian Orchard, Mass., exhibited a large number of valves of all sizes and descriptions, now largely used in street railway plants.

C. A. Schieren & Co., of New York, represented by C. A. Schieren, Jr., exhibited a roll of 3 ply belting 116 feet long, 72 inches wide, made for the Brooklyn City Railroad Company.

Mr. C. O. Mailloux, of the Metropolitan Railway Company, of Washington, D. C., was present, and in much request for pointers on storage battery traction.

A neat little souvenir in the shape of a vest pocket memorandum book was given to visitors by the Frost Veneer Seating Company of New York and Chicago.

P. Wall, Jr., was in charge of an exhibit of steel street car gongs and oilers, manufactured by the P. Wall Manufacturing Supply Company, of Allegheny, Pa.

Frank A. Magee looked out for the interests of The E. S. Greeley & Co., who also had an exhibit of supplies and of their admirable testing apparatus.

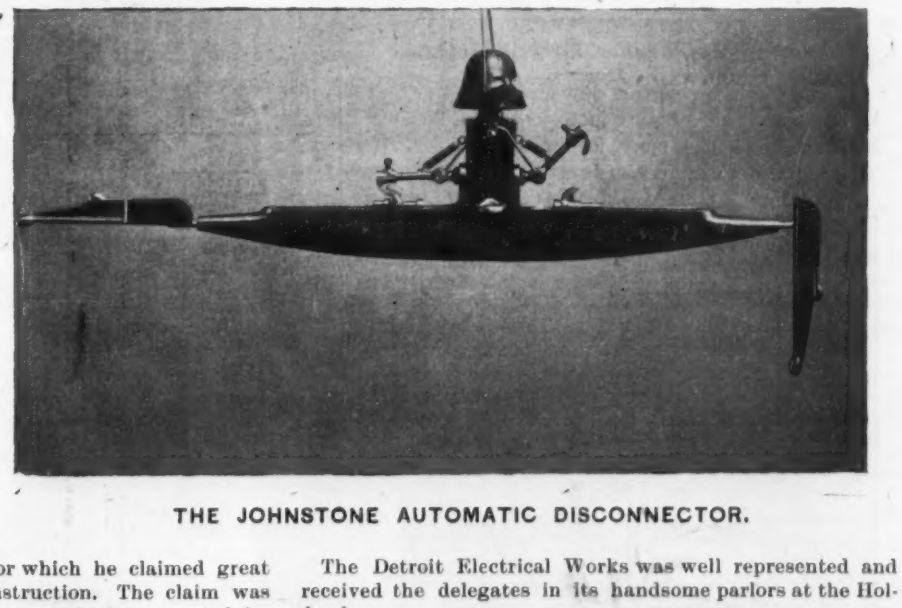
The Partridge Carbon Co., of Sandusky, O., was represented by A. S. Partridge and J. S. Speer, and an exhibit of fine carbon motor brushes.

The Van Dorn Iron Works Company exhibited a line of steel poles in the annex, which are in extensive use throughout the United States.

Mr. L. B. Whitney was the representative of Whitney & Sons, street car wheel manufacturers, of Philadelphia, at the Cleveland convention.

The Stirling Boiler Company was on the ground with plans and views of their boilers, which are in extensive use in electric stations.

H. M. Littell, of Cincinnati, showed his Mt. Auburn trolley, with anti-friction rollers, which has made 980 miles with one oiling.



THE JOHNSTONE AUTOMATIC DISCONNECTOR.

The Detroit Electrical Works was well represented and received the delegates in its handsome parlors at the Hollenden.

The W. Bingham Co., of Cleveland, had a handsomely mounted exhibit of tools, including wire gauges and cutting pliers.

Captain W. L. Candee represented the Okonite Company which has lately added Henry D. Stanley to its staff.

The W. H. H. Peck Company, of Cleveland, showed a line, of belting, tapes, vulcanized fibre, tubing, etc.

The H. M. Loud & Sons Lumber Co., of Au Sable, Mich., had an exhibit of octagonal cedar poles.

The Cleveland Cedar Company, of Cleveland, Michigan and Ontario, had a display of cedar poles.

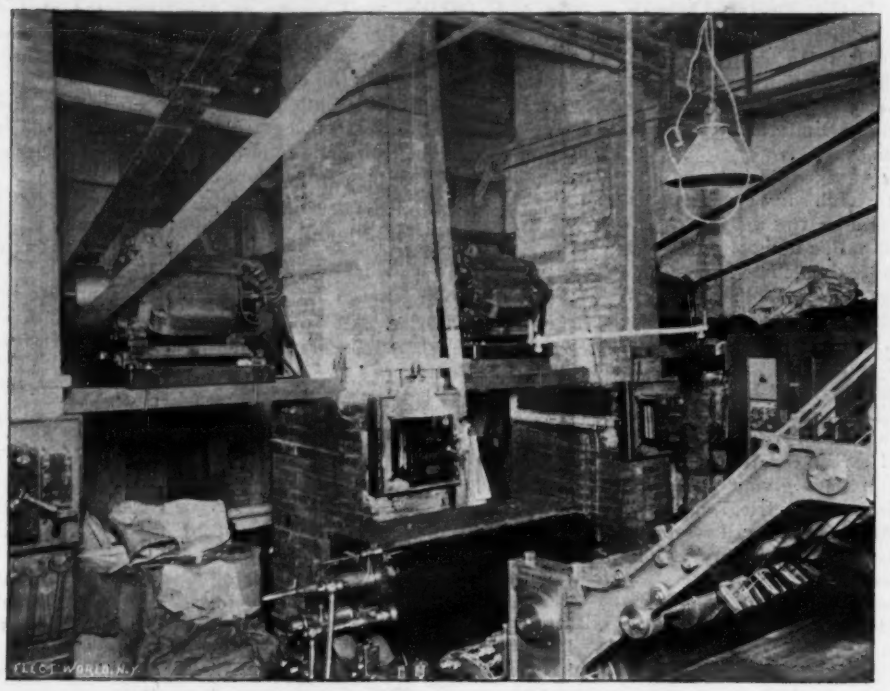
The Pittsburgh Steel Hollow Ware Company, Ltd., exhibited a line of rolled steel gongs.

Mr. John Kuehnle, of Detroit, had an exhibit of his patent trolley wheels.

Perret Motors Driving the Presses of the Brooklyn "Citizen."

The accompanying illustration represents three of the four Perret low speed motors installed by the New York office of the Elektron Manufacturing Company in the press rooms of the Brooklyn Citizen Association, Brooklyn, N. Y. The aggregate power of the motors is 48 h. p., divided into two 15-h. p. units, one 10 h. p. and one 7-h. p.

The central motor in the illustration, the 10-h. p., is belted to a large wetting machine, while the two 15-h. p. motors on the outside and one 7-h. p. machine not shown in the cut are belted to the main shaft, the belt speed on all being the same. The main shaft is divided into three parts by cut-off couplings, so that ordinarily each motor drives its own section of shafting, but should it be necessary at any time any motor may be made to drive any section of shafting by throwing in the couplings, or all three motors may be made to drive together. Each of the 15-h. p. motors drives a large Hoe press, while the 7-h. p. machine operates a number of job presses and cutters.



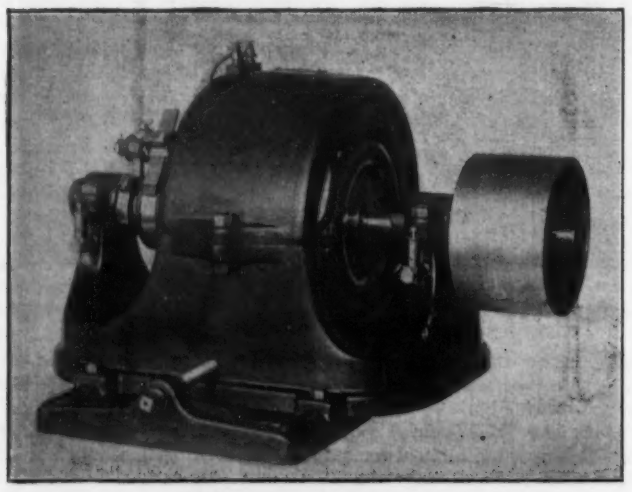
ELECTRIC PLANT OF THE BROOKLYN "CITIZEN."

The motors supplant a 60-h. p. engine and boiler, and by the division into four units a large saving in operating expenses is effected, as the 7-h. p. motor is the only one that runs continuously, the others being used only an hour or two each day for running off the regular edition of the *Citizen*. In addition to the saving in operating expenses, a very considerable floor space is saved by reason of the motors being placed about eight feet above the floor in a hitherto unused space between the supporting pillars under the sidewalk.

The plant has been in operation for about three months, and is probably the largest and most complete plant of its kind in a daily paper press room at the present time. The Perret motors were selected by the Citizen Association, after a careful investigation, for their low speed and the small amount of attention they require.

The Wagner Electric Motor.

We illustrate herewith a new electric motor that has just been turned out of the factory of the Wagner Electric Manufacturing Company, of St. Louis. Mr. Herbert A. Wagner, the inventor, has devoted a large portion of the past two years to improving his motor in every detail, and it is claimed that this motor possesses many features of superiority. As will be seen by the illustration, it is compact, with a heavy iron base, and occupying only a small floor space as compared with most other motors. The claims made for the Wagner motor are, that they embody all the most recent improvements in electrical and mechanical designs, and meet in every particular all the requirements suggested by the most advanced modern practice.



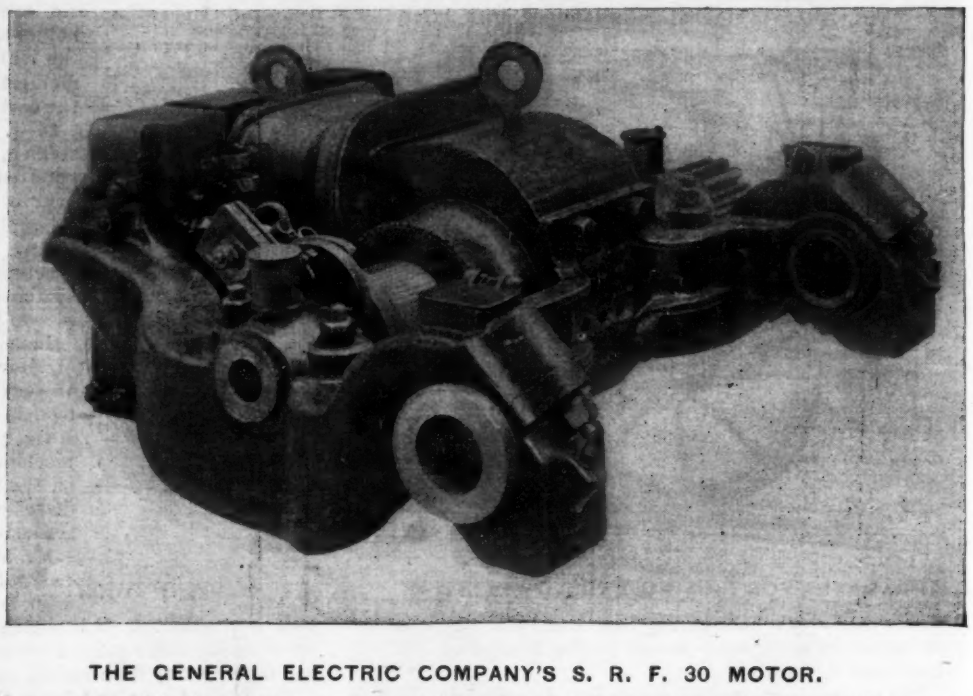
THE WAGNER MOTOR.

The number of parts is small, while the armature and field coils may easily be removed without disturbing the pillow blocks. The field coils are wound on spools, securing the highest insulation, while they are easily removed should occasion require. One of the principal features of this motor is its very low speed. All of the armature wire is completely embedded in iron core, while perfect ventilation is secured.

All of the bearings are self-oiling by means of a loose ring which takes up the oil in the boxes and feeds it on the bearings as required. By this means the motor requires oiling about once a month while in constant service. All of the bearings are mounted on universal ball sockets, so that the friction is reduced to a minimum. The brushes, which are self-feeding, may be changed while the motor is running, and there is also no sparking under any change of load. The brushes, being once adjusted, require no further attention except occasionally for renewing about three times a year. The Wagner motors are also reversible without changing or removing the brush holders.

These motors are perfectly adapted for alternating constant potential currents and on 500-volt circuits.

Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago, have the exclusive agency for six States.



THE GENERAL ELECTRIC COMPANY'S S. R. F. 30 MOTOR.

The General Electric Company's S. R. F. 30 Motor.

The many advantages of the single reduction motor for electric railway service have, during the past year, been so emphatically proven that the General Electric Company has redesigned its old double reduction F. 30 motor, making it a single reduction machine, and designating it as the S. R. F. 30 railway motor. In compliance with the demand already apparent for the conversion of F. 30 motors, the company is now rebuilding for many of its customers a considerable number of these machines.

In effecting the change, the side arms, nose plate, intere mediate shaft, pinion and gear of the old F. 30 motor have been discarded, and replaced by newly designed side arms, which support the motor proper. As will be seen from the illustration, they occupy a position exactly the reverse of that in the F. 30. The nose plate becomes a support to the pole pieces, and the pinion and gear are similar to those used on the General Electric Company's W. P. railway motor.

By doubling the turns or convolutions in the armature winding, and leaving the field spools unchanged, two very important improvements have been secured, the armature speed is reduced one-half, and the strength of the torque of the motor doubled.

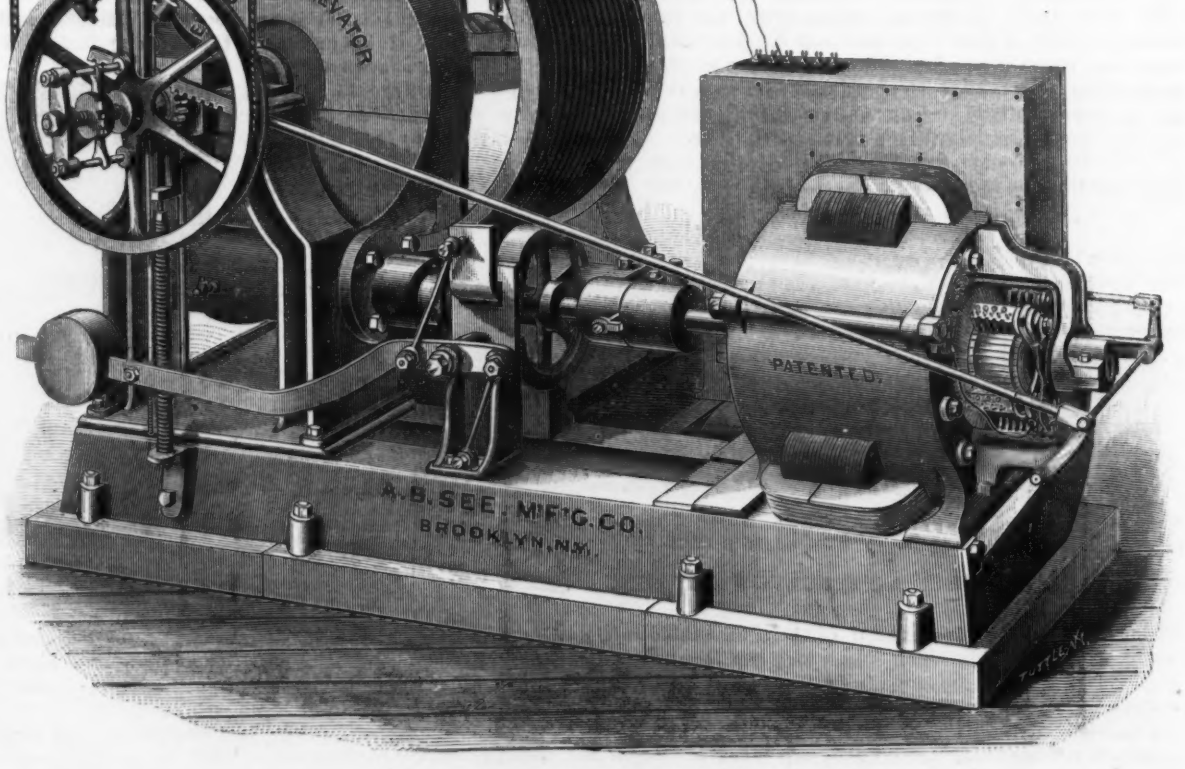
An improvement has been effected in the arrangement of the armature bearings, facilitating lubrication. The axle and armature bearings are now similar, and the same kind of grease can be used on both.

The efficiency of the new S. R. F. 30, when compared with that of the F. 30, shows a decided increase in favor of the new type, although its speed under similar condition of strength of fields is slightly less. The amount of heat developed after a run under full load is also considerably less than in the F. 30.

The results of the trial tests of the S. R. F. 30 motor tend to show that the transformation of the F. 30 from a double reduction to a single reduction motor will be satisfactory wherever effected.

The A. B. See Electric Elevator.

An elevator which is rapidly coming into use, and which is giving excellent satisfaction, is that manufactured by the A. B. See Manufacturing Company, of Brooklyn, N. Y. The electric elevator is not new in the field, but this type contains some very important improvements, and has avoided some of the objections which have been held against the ordinary form. Other electric elevators are controlled by a switch in the car itself, by means of which the circuit is broken or closed, and resistance thrown in or out, and the movement of the elevator thus regulated. In the A. B. See elevator, however, this is done automatically and is entirely taken out of the hands of the ignorant or



THE A. B. SEE ELECTRIC ELEVATOR.

careless attendant. The motion of the elevator is controlled by means of the ordinary hand rope. This, as will be seen from the accompanying illustration, transmits its motion to a wheel, and thence by a rack and pinion and appropriate mechanism to the switch and rheostat of the motor. The operation of this device is very simple. Suppose, for instance, that the elevator is at rest and it is desired to ascend; the attendant simply pulls down on the elevator rope, which partially rotates the wheel and the motion is transmitted to the switch, which is closed, and to the contact arm of the rheostat, which slowly cuts out the resistance. The motor thus starts up gradually, but quickly gathers speed. If it is desired to stop, a slight movement of the rope in the opposite direction will again cause the wheel to rotate and throw the spring snap switch so as to instantly break the circuit without any danger of forming an arc, and cut in the resistance. If it is further desired to reverse the motion of the elevator and descend, it is only necessary to give the rope a stronger pull so as to throw the wheel over about half a revolution, which reverses the double pole switch and cuts out the resistance as described above. It is purposely arranged so that a considerable movement of the rope is necessary in order to reverse the direction of motion of the elevator, because this effectually prevents the sudden reversal of the motor which is so dangerous to it. In the ordinary form of electric elevator it is possible for the attendant to instantly reverse the motor at the risk of burning it out or seriously injuring it.

The automatic switch is one of the best features about this elevator. It is simple but positive in its action, and is practically indestructible. The spring switch obviates all danger of arcs, and the contact pieces are screwed on instead of being riveted, so that they can be easily and quickly replaced.

The advantages of this automatic method of control can be readily seen. Any person, however ignorant of electrical matters, or however careless, can run the elevator without the slightest danger of injuring the motor or any of the mechanism. It is impossible to bring the elevator to a sudden stop or to start it up so quickly as to make the

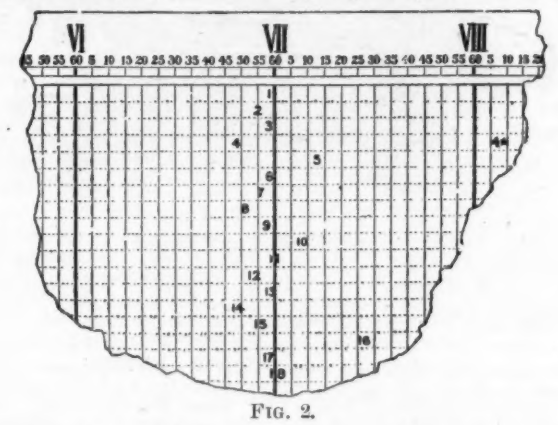


FIG. 2.

motion so disagreeable to the passengers, if, indeed, it does not cause any other trouble. It is often complained, where electric elevators are in use, that their sudden starting up under heavy load causes a violent fluctuation in the incandescent lights which are fed from the same source. With this elevator this cannot take place.

The elevator complete is manufactured by the A. B. See company at its plant in Brooklyn, N. Y., with the single exception of the worm gears, which are furnished by the Brown & Sharpe Co., of Providence, R. I. The company also manufactures its own car, both for freight and passenger service, and they are of exceedingly neat design and strong and durable in construction. The Perret motor is used, and is found to stand the wear and tear of this sort of work excellently. The whole mechanism is mounted on one base, occupying comparatively little room, and so arranged that every part is easily accessible. This is especially important in the case of the switch and rheostat, which are placed in an iron frame, and convenient for inspection at all times. The A. B. See company is crowded with orders, and its works are running at full capacity.

Bolte Automatic Timekeeper.

The Bolte automatic timekeeper is a new device for keeping accurately a record of the time of arrival and departure of employés. Fig. 1 shows the complete detail

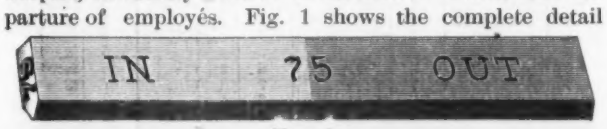


FIG. 3.

with clock dial and the hand making the registration. Fig. 2 is a section of the upper part of the record sheet. The cylinder around which this record sheet moves turns in time with the hour hand, making one revolution every 12 hours. The heavy line marked seven o'clock indicates the hour at which the workmen are expected to arrive. The numbers recorded on the left of this line are early, whereas those on the right are late. Each of the light colored lines indicates five minutes; therefore, any one registering three lines to the right of the seven o'clock line would be 15 minutes late, and as the proprietor enters his establishment in the morning one glance at the clock will indicate just those employés who are late or absent, and how many minutes they are behind time.

In Fig. 3 is seen the registering key, full size. Each workman draws his pay according to a certain number, and in this case the one shown is No. 75. This number appears in raised letters on each end of the key; the end marked "in" being nickel, the end marked "out" being of copper. The indication of an employé registering "out" is shown by a star being placed after the number, thus—75*.

The value of this device is apparent. Each workman makes his own registration and cannot complain of the timekeeper. No collusion is possible between the timekeeper and employés. By actual use it has demonstrated the fact that employés are much less likely to be late, as by the use of the Bolte automatic timekeeper not only the workmen themselves are able to inspect the record, but

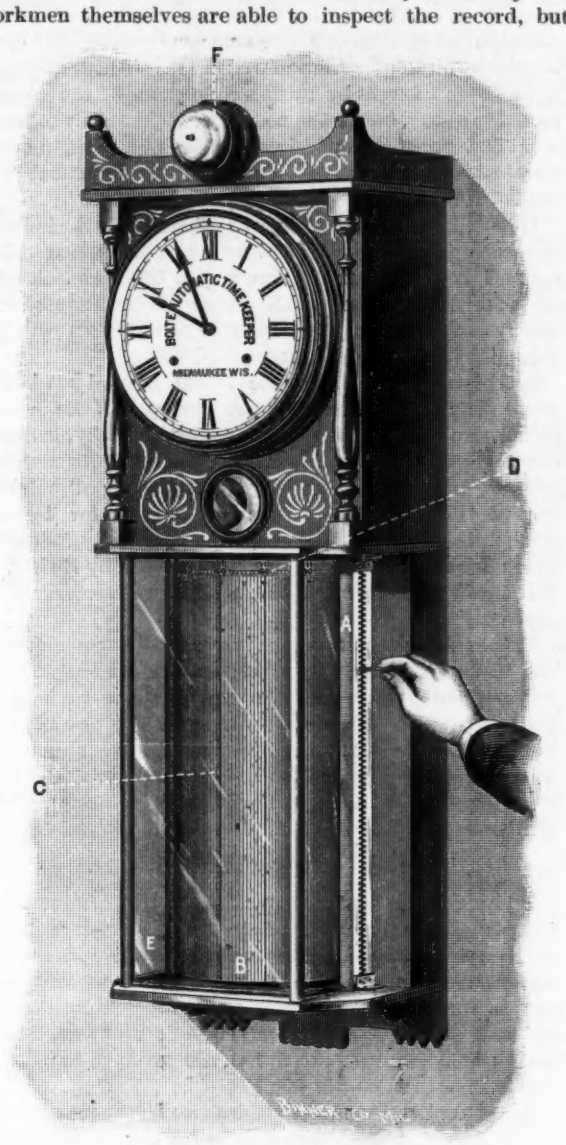


FIG. 1.

their employers are able each day at a glance to ascertain the numbers and names of those who are arriving on time, or others who are habitually late or absent. The device will be placed on the market by the National Time Recorder Company, 361 and 363 East Water street, Milwaukee, Wis.

The Law of Hysteresis.—Part II.*

BY CHARLES PROTEUS STEINMETZ.

The tests communicated in the former chapters seem to prove that molecular friction in magnetizable materials under variations of magnetization is much more constant a phenomenon than has been usually supposed. The connection between loss by molecular friction H and amplitude of induction L seems to be absolutely rigid, while the connection between induction L and M. M. F. F is decidedly flexible, especially with lower M. M. Fs., because L does not only depend upon the present, but also upon the former condition of F and L and even upon the time by a kind of viscous hysteresis or better called sluggishness as observed by Ewing, and also noticed by me under certain circumstances on the magnetometer, so that for a given L the corresponding F can have a large range of different values, while H is univalent.

It is in accordance with this that, for the correspondence between L and F, no simple law could be found which holds over the whole range, while the law of interdependence of L and H evidently does so.

Consequently I believe that we shall have the best chance to arrive at a fuller understanding of the phenomenon of magnetism when starting in the research from the correspondence H—L. However, this law of 1.6th power I believe is not a differential law, like for instance the quadratic law of gravitation, but is an integral law like the law of probability with which it seems to be connected in some way.

In the former chapters we have for the determination of the molecular friction made use largely of the cyclic curve of hysteresis, that is, the correspondence between the magnetic induction and the M. M. F. when the latter performs a complete cycle.

If the magnetization is given as magnetic intensity or moment, and the M. M. F. as field intensity H, the area of this loop directly represents the energy expended by the variation of the M. M. F., in ergs per cm.^{3} and cycle.

If the magnetization is given as a magnetic induction, L or B, the M. M. F. as field intensity, H, the area has to be divided by 4π, to give the energy. But if the M. M. F. is given in current turns per cm., the area is equal again to the consumption of energy, in ergs, or, if the M. M. F. is given in ampère turns per cm., F, since 1 ampère $= 10^{-1}$ absolute units, the area is 10 times the energy in ergs. This is another reason why I preferred the use of ampère turns per cm., F, as M. M. F., to make this area directly equal to the hysteretic energy, with a power of ten as factor, as usual in our system of practical units.

Giving L in volt lines, F in ampère turns, the area is directly equal to H in volt seconds or joules.

As said before, this looped curve of hysteresis measures the energy expended by the M. M. F. during a complete cycle.

It has been assumed, then, that the area of this loop represents the energy consumed by molecular friction in the iron. This is a fallacy. The area of this looped curve is not the energy dissipated by molecular friction in the iron. Warburg and Ewing have shown—the former by supposing the cycle of M. M. F. performed by changes in the position of steel magnets, and determining the energy expended in performing these changes in position; Ewing by supposing the magnetic cycle produced by a cyclic variation of the exciting current in a magnetizing helix and calculating the energy consumed by the E. M. Fs. induced in the magnetizing helix by the cyclic variation of magnetic induction—that the energy expended by the M. M. F. during a complete cycle is equal to the area of this looped curve.

Hence, it has been concluded that the area of this loop represents the energy expended by molecular friction in the iron.

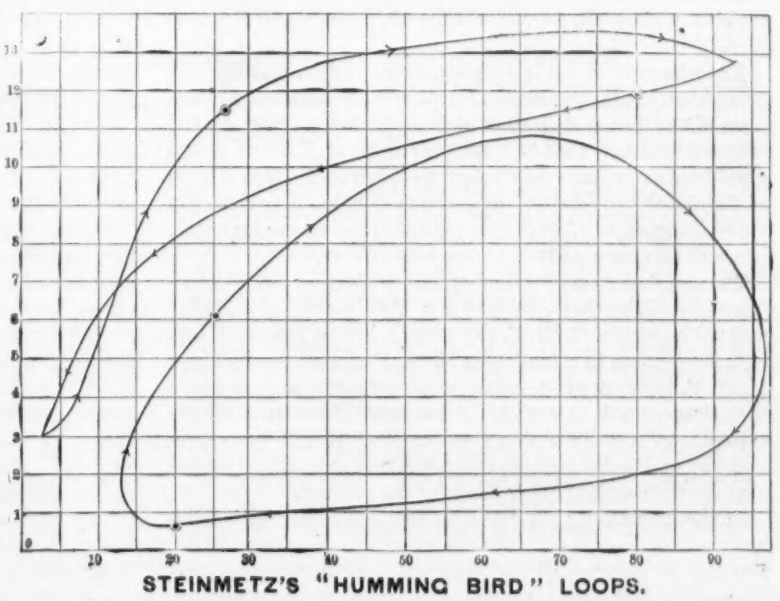
Here is the mistake in the conclusion. For—

"*The area of the looped curve of hysteresis represents the energy dissipated by molecular magnetic friction when, and only when, during the magnetic cycle, neither energy is exerted upon the magnetic circuit by another source of energy nor work done by or in the magnetic circuit.*"

Instances of the first case have been observed—and often misinterpreted.

For instance, on pages 114, 115, and on pages 319, 320 in Ewing's "Magnetic Induction in Iron and Other Metals," is shown that under the influence of vigorous vibration, or of an alternating current passing lengthwise, that is, in the direction of the magnetic flux, through the magnetized wire, the looped curve of hysteresis more or less collapses, hysteresis disappears. But not so molecular friction. The energy dissipated by molecular friction is simply derived, not from the cyclic varying M. M. F., but from the force vibrating the wire, viz., from the alternating current. For when violently vibrating a magnetized body, molecular motions are produced by the mechanical force which consume a part of its mechanical energy. But the best proof is that, under the circumstances, by the action of such a mechanical force, the magnetic loop made by the correspondence of L to F can be overturned, so that the rising curve of magnetization is higher than the decreasing—that is, the cycle represents, not expenditure, but production of energy. Since obviously molecular friction cannot produce energy, here the action of mechanical force is plain.

In rotating the keeper before the poles of an electromagnet, magnetism and magnetizing current are made fluctuating, and in plotting the magnetism as a function of the M. M. F. we derive such an overturned loop.



STEINMETZ'S "HUMMING BIRD" LOOPS.

Two such overturned loops, based on actual tests made on an alternating dynamo of the "humming bird" type, are shown in the accompanying figure.

Here simple mechanical energy has delivered not only the energy dissipated by molecular friction in the iron, but also the energy exerted by the varying magnetism upon

* An abstract of Chap. V., headed "Conclusions and Fallacies," of Mr. Steinmetz's elaborate paper read before the American Institute of Electrical Engineers. An abstract of Part I. of this paper was published in THE ELECTRICAL WORLD of Jan. 30, 1892.

the M. M. F., and while the M. M. F. does not expend, but receives energy, the mechanical force of rotation expends energy. Consequently, if the magnet is not an electromagnet, but a steel magnet, it will be strengthened, as is well known. Another instance is, if we alternately tear the keeper off a permanent magnet and put it on again, after a number of cycles the permanent magnet will come into a stationary condition, neither lose nor gain in magnetic potential. Nevertheless, by molecular friction in these parts of the steel magnet, and in the keeper, where the magnetism varies in strength and direction, energy is dissipated. This is derived, consequently, from the source of mechanical energy. The case may be similar in dynamo armatures. The opposite phenomenon, that the hysteretic loop represents more energy than expended by molecular friction, is still more frequent.

For instance, if eddy or Foucault currents are induced in the iron, the hysteretic loop is considerably widened, and represents now not only the energy expended by molecular friction, but also the energy spent by the eddies.

But since the eddy currents are electric currents also, and represent a certain M. M. F., in this case the difficulty is overcome by stating that not the impressed M. M. F., but the M. M. F. resulting from the impressed M. M. F. and the M. M. F. of eddy currents, has to be considered in determining the energy spent by molecular friction. This is still more plain in the case of the transformer, where it evidently would be incorrect to represent the induction L only as a function of the impressed M. M. F. of primary current, instead of the resultant M. M. F. of primary and secondary current.

But in the magnetic circuit built up of iron filings we have a case where without the existence of secondary currents the hysteretic loop represents more energy than spent by molecular friction.

In this case evidently mechanical motions take place in the iron filings, which consume energy derived from the M M. F.

The mechanism of action may be about the following: When the M. M. F. increases, more and more iron filings fall in alignment, by setting up chains of filings as soon as the M. M. F. is large enough to cause the motions required hereto. When the M. M. F. decreases, these chains of filings will be maintained down to a much lower M M. F. than was required to produce them. The consequence hereof is that—independent of molecular hysteresis—for the M. M. F. on the decreasing branch the apparent magnetic reluctivity will be considerably smaller, hence the induction larger, than for the same M. M. F. on the increasing branch—that means, the hysteretic loop will be widened, and widened by that amount of energy expended by the mechanical motions of the iron filings.

The same is seen in the case of the loose wire spirals, where the increasing M. M. F. brings the spirals in closer contact, while in the case of the crosswise laminated iron no such expenditure of energy is possible, and, indeed, experiment gives a much closer agreement between the hysteretic loss of the cross laminated iron and that of the material proper, the difference being small enough to be explained by the unequalities of magnetic distribution.

To test the correctness of this reasoning I dipped the tube containing the iron filings in melted paraffine After having cooled down I made another set of tests of the hysteretic cycles of these iron filings (magnetometer tests along stratification) and got the values:

$\pm F.$	$\pm L.$	$H.$	η
87	892	2.606	.04959
50	616	1.122	.03850
31	424	520	.03252

while the tests of these iron filings without paraffine had given: $\eta = .0656$.

The tests show a considerable decrease of the value of η, when the filings were hindered in their motion by filling the interstices with paraffine, especially for M. M. Fs., and thereby prove the assumption.

These tests were made on a hot summer day, and the still comparatively large values of η seem to indicate that motions of the filings still took place, especially under larger magnetic strains, that is, that with a M. M. F. $F = 87$ the paraffine partly gave way before the push of the iron filings; at the same time these tests prove conclusively that the value η decreases, if motions of the iron filings are impeded, as was to be expected.

The simplest case of phenomenon is that of an electromagnet with keeper excited by a slowly alternating current; at a certain M. M. F. the keeper will be attached, and then held down to a far lower M. M. F. since a much larger M. M. F. is required to attract the keeper over a distance than is required to keep it in contact. Consequently the loop performed by such an electromagnet will not represent the molecular friction only, but this molecular friction plus the mechanical work done by the magnet.

In the alternating current synchronous motor with wireless shuttle armatures the whole mechanical energy is derived by an enlargement of the cyclic curve of magnetization of the field magnet.

Very likely in the amalgam of iron we have such a case also.

An interesting fact is, then, that the law of the 1.6th power holds for iron filings also, and consequently the expenditure of mechanical energy in the motions of the iron filings must follow the same law, and nevertheless these iron filings do not resemble at all the conditions claimed for the molecules of paramagnetic substances. For these iron filings are neither permanent magnets, nor are their distances infinitely large compared with their dimensions, as must be assumed for molecules.

This explains also why the coefficient η is largest for very slow cycles, decreases, and after reaching a minimum for a moderate frequency increases again. This explains also the corresponding variation of absolute saturation.

That the law of the 1.6th power holds, nevertheless proves, that this law does not depend upon a particular constitution of the material, but is of more general meaning.

Another consequence is, if, as we have seen, by mechanical vibrations the hysteretic loop is made to collapse, this does not mean that by shaping the magnetic circuit so that the alternating magnetism produces vibration the loss of energy by molecular friction would be avoided or overcome, as has been thought by misinterpretation of the tests referred to above, but in the contrary, such an arrangement would have just the opposite effect, to add to the unavoidable loss by molecular friction the loss by mechanical vibration.

It is not yet proved, indeed, that under the influence of mechanical vibration, or of an alternating longitudinal current the molecular friction is still the same, although this is made very likely by all that we know about the constancy of this molecular friction. Further tests will give more light upon this matter.

It is highly probable that the initial inward bend of the magnetic characteristic, and the deviation of the metallic reluctivity from the linear law, caused thereby, is merely due to the expenditure of energy by M. M. F. for molecular friction, and that consequently, if the energy of molecular friction is derived from another source, for instance, mechanical vibration, the magnetic reluctivity follows the linear law from the beginning, as observed by Ewing, and the inward bend of the magnetic characteristic disappears.

This explains the enormous increase of permeability for low M. M. Fs., caused by vibration. In the absence of an external source of energy the rise of magnetic induction following the linear law of reluctivity is for low M. M. Fs. made impossible by the fact, that in this case more energy must be expended by molecular friction than would be derived from the M. M. F. by the E. M. F. induced in the exciting circuit.

THEORY OF MOLECULAR MAGNETS.

Relatively the best explanation of the phenomena of magnetic induction and of magnetic hysteresis is afforded by the assumption that the molecules of the paramagnetic materials are permanent magnets, which, as long as no outside directing force H acts, have no definite direction and consequently no resulting magnetic moment, but, following their mutual attraction, are grouped in pairs and chains.

By the application of an outside force H, the molecules are turned into alignment with H, against the opposing forces of mutual attraction, and hereby deflected by a certain angle. Now, for certain positions of molecules exists an angle of deflection, which makes H a maximum, so that for a further increase of the angle of deflection a smaller value of H is required, and consequently the H necessary to reach this critical angle of deflection overthrows the molecule—an irreversible process, which represents the loss of energy by what is called molecular friction.

This theory cannot, indeed, be considered an explanation of the phenomenon of magnetism, since it refers it back to permanent molecular magnetism again; it is merely an explanation of the particular shape of the magnetic characteristic and of the loss by molecular friction.

This theory of molecular magnets, and unstable equilibrium reached by them for a certain H, has been worked out especially by Ewing. But in determining the fundamental equation of this theory, the equation of equilibrium of a pair of molecules acted upon by an outside force H, Ewing makes an assumption which is in contradiction to all our present knowledge of molecular physics.

All the facts of the kinetic theory of gases, of thermodynamics, etc., lead to the conclusion that the dimensions of molecules are infinitely small compared with their distances.

But Ewing supposes the distance of the centres of molecular magnets is not much greater than their length, to be able to make the assumption that the attracting force between the magnet poles pointing away from each other is negligibly small compared with the attraction of the poles pointing toward each other, while both forces become nearly equal by assuming the distance of the molecules very large compared with their dimensions. Ewing's assumption introduces a quadratic term into the equations, where we must get a cubic term, and essentially changes the conditions of unstable equilibrium.

In a body as a whole the greatest part of the magnetic induction and the loss by molecular friction simply depend upon that law of probability which determines the distances of molecules.

This conclusion is, indeed, derived under the assumption that the molecules act upon each other only in pairs. To consider the more general case of mutual action of more than two molecules would carry me too far here, the more as the assumption of an arrangement in pairs cannot be so far from giving an approximately true picture of the phenomenon, since the mutual action depends upon the third power of distance, and consequently only the next molecule will have a greater influence.

As conclusion, we derive then,

"*In rough approximation, the magnetic induction and the molecular friction depend upon the M. M. F., by the law of probability of molecular distances.*"

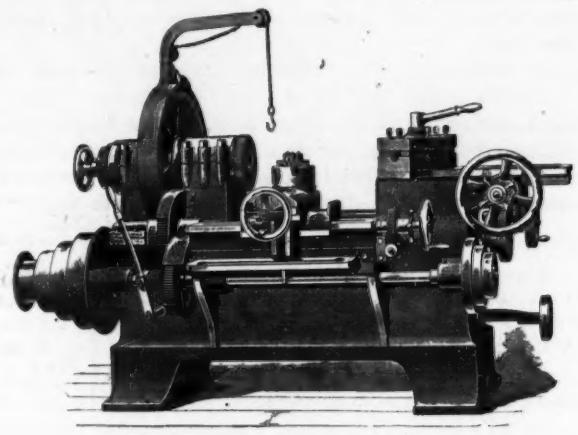
The point of maximum increase of induction is not the same as the point of maximum increase of molecular friction, since different factors enter into the function of probability.

The law of hysteresis of the 1.6th power is the interdependence of two functions depending upon the same law of probability, hence can be of simpler form than either function.

An Extra Heavy Engine Turret Lathe.

The accompanying illustration shows an extra heavy engine turret lathe manufactured by the Lodge & Shipley Machine Tool Company, of Cincinnati, O., which is the outcome of many years' practical experience. It is designed to handle cast iron work on the same plan that the screw machine handles iron and steel studs. The turret on the saddles is an adjustable iron box tool and will make diameters from 30 inches down, and will, when set, make four sizes on the same piece and duplicate them any number of times.

As a boring lathe alone it is of great value, and on account of its stiffness it will do heavy boring with much greater facility than the ordinary boring lathe. It will be appreciated by engine builders as capable of performing three operations at one time on large quantities of work



Lodge & Shipley Lathe.

pertaining to the construction of either Corliss or slide valve engines. The two saddles carrying the tools may be used in the same way that box tools are now used for large work, and their great rigidity, together with the fact that they go on both sides at once, will produce given different diameters either straight or taper, with heavy mushet steel tools that require regrinding but once a day on account of the great amount of metal backing up the edges. It has a 30 inch swing, and while one pulley of ample dimensions is used, it will be seen that a much larger one may be employed when the work in hand requires it. The bed is cast in one piece from the floor to the centre of the spindle bearings, and the slides upon which the saddles move are also part of the bed. The peculiar construction for obtaining tapers permits of forms and shapes being readily made from a forming plate of almost any design. It has every advantage of a first class chuck lathe.

Moonlight Tables for November, 1892.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of November, under his modified form of moon schedule:

TABLE NO. 1. Standard Moonlight, Philadelphia System.

Date.	Light.	Date.	Exting.
1	1:35 A. M.	1	5:30 A. M.
2	2:50	2	5:30
3	No light.	3	No light.
4	No light.	4	No light.
5	No light.	5	No light.
6	5:20 P. M.	6	7:20 P. M.
7	5:20	7	8:20
8	5:20	8	9:20
9	5:20	9	10:30
10	5:20	10	11:40
11	5:15	12	12:50
12	5:15	13	1:55
13	5:15	14	2:55
14	5:15	15	3:55
15	5:15	16	4:55
16	5:15	17	5:50
17	5:10	18	5:50
18	5:10	19	5:50
19	5:10	20	5:50
20	5:10	21	5:55
21	5:10	22	5:55
22	5:10	23	5:55
23	5:10	24	5:55
24	7:45	25	6:00
25	8:55	26	6:00
26	10:05	27	6:00
27	11:15	28	6:00
28			
29	12:25 A. M.	29	6:00
30	1:40	30	6:05

Total hours lighting, 213.5.

TABLE NO. 2. Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	5:25 P. M.	1	12:00 M
2	5:25	2	12:00 M.
3	5:25	3	12:00
4	5:25	4	12:00
5	5:25	5	12:00
6	5:20	6	12:00
7	5:20	7	12:00
8	5:20	8	12:00
9	5:20	9	12:00
10	5:20	10	12:00
11	5:15	12	12:50 A.M.
12	5:15	13	1:55
13	5:15	14	2:55
14	5:15	15	3:55
15	5:15	16	4:55
16	5:10	17	5:50
17	5:10	18	5:50
18	5:10	19	5:50
19	5:10	20	5:50
20	5:10	21	5:55
21	5 10	22	5:55
22	5:10	23	5:55
23	5:10	24	5:55
24	5:10	25	6:00
25	5:05	26	6:00
26	5:05	27	6:00
27	5:05	28	6:00
28	5:05	29	6:00
29	5:05	29	M.
30	5:05	30	

Total hours lighting, 297.80.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Oct. 22, 1892.

New York Financial Stock Market.— The market was strong, active and generally upward. There were many who anticipated that the broken week would create a feeling of uncertainty and cause a general closing out of stocks on Thursday. Owing to the firm tone, holders were prompted to carry over their securities. The railroad stocks were the feature. There was a decided falling off in shipments of currency to the interior, caused chiefly by the cessation of the demand from the West and Northwest. It is thought that this will be permanent. Shipments to Southern points may continue heavy for some time. There was a decided drop in money rates. On Wednesday 6 to 7% was quoted on call loans, due to the preparations for the holidays. On Thursday the rate dropped as low as 3¼ per cent., the closing being at 4 per cent. Every sign now points to an active bull market next week in the general list, with perhaps soft spots in specialties like the coal stocks and New England.

New York Electrical Stock Market.—The market in electrical stocks was the most quiet that has reigned in weeks. There seemed to be an utter indifference in all except Western Union and General Electric. Transactions in these did not begin to approach the average of past weeks. The cause is not hard to explain. The various securities were almost without feature. They have had a marked advance, and under present conditions are considered high enough. Money is growing tighter and the uncertainties of a presidential election are drawing nearer. Wall street prides itself upon being prepared for any contingency, and it is quite probable that the industrials will not be favorites until after Nov. 8. North American experienced its usual daily sales in small amounts. The quotation ranged about 12⅞, although 13⅛ was touched at the opening on Monday. The fluctuations in Northern Pacific, of which it is a large owner, did not affect the stock. Reports from the various cities where it is conducting electric enterprises are very encouraging.

Commercial Cable had another week of absolute quiet. The bids remain at 164 and the asking price at 169. There is going to be the biggest kind of a reorganization in the various press and news associations on Jan. 1. The American Press is threatened with losing its Western American Association. Ruyter's agencies for Europe has already withdrawn. The United Press is also making a strong bid for additional connections that will strengthen its service. Messrs. Bennett of the *Herald* and Pulitzer of the *World* have in the city from Europe. A conference of A. P. magnates will follow, and the association will undoubtedly be reorganized and strengthened. The matter is in such chaotic condition that it is impossible to predict just how the various telegraph and cable companies are to fare by reason of the changes, but it is safe to say that Commercial Cable, owing to its newspaper backing, will get a fair share of the business. This contingency may perhaps be construed so as to account for the rapid and steady advance which the stock has had during the past six months.

Western Union.—On Monday of this week the stock again crossed par, selling at 100⅛. From that date it sold off, closing at 98⅛ Thursday. The weakness is attributed to the coming issue of $10.000,000 additional stock. It has required several years to absorb the old surplus floating stock. The security is now in a condition so that it fluctuates in a greater or less degree upon its merits. The new stock will render it much more sensitive to rumors. For this reason investors are cautious, and this in turn keeps the stock below par, notwithstanding the efforts of insiders to place it above the 100 mark. There was a heavier movement in the bonds than has occurred in some weeks; $31,000 sold in small lots at 103⅛ to 103½. The company's earnings last week were $281,000; increase, $8,000. It paid $1,500,000 for its Chicago building, recently purchased by the Phœnix Insurance Company. On the coming Wednesday the distribution of the stock dividend of $10,000,000 will be made. We understand that the company has in contemplation the re-wiring of its lines with the best grade of copper wire. The Bell telephone in years to come is liable to be a formidable competitor, and Western Union fully realizes that the first step to meet any competition from this source is better equipment.

General Electric.—On Monday the highest quotation of the week, viz., 117½, was recorded. At the close last week the stock sold ex-dividend, dropping two points to 116½. The recovery was but partial and the closing weak at 115 to 115½. It is said that the Lynn people were large sellers of General Electric and that their action created some asperity in General Electric circles and, undoubtedly, the real cause of the weakness was realization. The buying two weeks ago was very heavy. The stock was held until the dividend was paid, and then closed out. The total transactions for the week were very light, comparatively speaking. We look for a little more activity next week, and possibly higher values. The debenture 5 per cent. bonds, to the amount of $13,000, sold at 105¾ to 105⅞.

Edison Electric Illuminating was quiet and strong at 105¾ to 106, the latter figure being the closing and the bonds advancing from 106⅞ to 107¼ on small sales. The fight between the company and the New York Board of Underwriters is in *statu quo*. Interested parties look for a compromise.

American Telegraph and Telephone Company.—The stock was not traded in during the week; at the close 85 was bid and 87½ asked. The distance by wire is about 1,200 miles. The New York-Boston service is so crowded that re-arrangements and additions will have to be made. The rate from Chicago to New York for a five-minutes talk is $9, and from New York to Boston $2. The through rate will probably be $11.

WALL STREET NOTES.

The Edison Electric Illuminating Company, of Boston, has declared a quarterly dividend of 2 per cent., payable Nov. 1, to stock of record Oct. 18.

The following from the *Commercial Bulletin*, of Boston, is given for what it is worth: "The General Electric Company is fortunate in having all Wall street practically at its back. Any one who has been much among the New York houses will recognize in the above statement a great truth. The unanimity with which all the big men of the street praise the General Electric Company is astonishing. Drexel, Morgan & Co. are its friends, and their immense following all believe in it. Keene and White have a good word to say for it, and these good words have been repeated from one to another down to the rank and file of the traders. This does not prevent the existence of considerable friction in the General Electric Company, however. Mr. Coffin is a very clever man; he has met with nothing but success here in Boston, but, like many other successful men before him who have thought themselves as big as some New Yorkers, he is liable to ultimately find himself mistaken. They don't do things in New York as they do elsewhere, and a man who tries to 'monkey' with Morgan, Keene or White is playing with loaded guns. The statement has been denied that Coffin has sold out a part of his General Electric holdings on the Drexel-Morgan crowd and we believe the denial, but some holders in this vicinity parted with some thousands of shares at the time the New Yorkers were endeavoring to make the stock as strong as possible, and to say that J. Pierpont Morgan and the others are wrathy, expresses it but mildly. It is believed that certain Lynn people were the sellers, who had given their word to Mr. Coffin that they would obey his orders regarding the sale or retention of the stock, and that by their action they placed Mr. Coffin in a very ticklish situation. The matter was explained to the New Yorkers and settled satisfactorily upon the understanding that it should not again happen. In other words, as we understand it, President Coffin has made himself responsible for the actions of several large New England holders of General Electric stock. The responsibility thus assumed is an onerous one, because should Drexel, Morgan & Co. discover that a sharp trick had even been attempted on them, orders would probably instantly be given to sell every share of stock in the office. With men like Keene and Morgan the sacrifice of a quarter or half a million dollars is not a consideration when they discover that some one has tried to play 'possum' with them. They are good men to have with one, but disastrous to have against one."

Pittsburgh advices are that in consequence of the receipt of large orders for their new lamps and lighting apparatus generally the Westinghouse company has been compelled to put on an extra force. The machinery for the manufacture of 5,000 new lamps every 10 hours is nearly completed and shipments about to begin.

Closing Quotations.—The following were the closing quotations of electric stocks on Thursday, Oct. 20, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Low-est.	High-est.	Bid.	Ask'd.
American District Tel....	100	3,825,000	....	....	59	60
American Tel. & Cable..	100	14,000,000	....	....	85	87½
Central & So. Am. Tel....	100	6,000,000	....	....	....	....
Commercial Cables.....	100	7,716,000	....	....	164	169
Gold Stock & Tel	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	98¼	100⅛	98⅛	98⅞
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	....	....	....	....
Collateral Trust 5's....	1,000	8,181,000	103⅛	103½	....	....
North American.....	100	39,767,200	12⅛	13¼	13	13⅜
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	105¾	106	105¼	106⅛
" " 1sts	...	.....	106⅞	107¼	....	....
" " Deb's	...	.....	....	....	....	....
Edison El. Il. of Brooklyn.	100	750,000	....	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El Light.....	100	1,000,000	....	....	....	65
General Electric.....	1,000	50,000,000	117⅛	115	115½	116½
Debenture 5's	....	.....	105¾	105⅞	....	....
Automatic Exhibition Co. ...		2,500,000	....	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E & M. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....		....
E. & M. Co. Assg.....	50	5,038,116	....	....	....	....

BOSTON, Oct. 22, 1892.

Boston Financial Market.—The general conditions and prospects of the market at the opening of the week were certainly favorable and promised good results for brokers and the public alike. However, the market has not yet become a broad one, and the activity centred almost entirely in a few specialties; in fact, when the market changes now-a-days the improvement generally runs along certain lines, rather than a general broadening in speculation throughout the list. Traders turn from one thing to another and the general market is affected only in sympathy with what they may be working on. New England railway stock has naturally absorbed a majority of the interest in this market, and with it Bay State Gas, and Atchison, Chicago, Burlington and Quincy have supplied nearly all the trading. Two holidays at the end of the week served to keep the public from taking a very active hand in matters on the street. On Wednesday prices were inclined to break, and there were weak spots in New England and Atchison, but the whole list closed very strong on Thursday, promising renewed interest next week, and no doubt a much better market. Money rates are inclined to greater firmness. Call money is worth 5 and 5½ per cent., and most time loans are made at 6 per cent., which rates are from ½ to 1 per cent. stronger than at the beginning of the week.

Electrical Stock Market.—Among the electric stocks one finds only an inclination to quietness and weakness. A few selling orders would depress both General Electric and Westinghouse many points, but of the two the former gives the greater evidence of weakness. It opened on Monday strong at over 117, but each day since shows a gradual decline, and at the closing at 115 there seems little in it to attract one. Rumors of Mr. Edison's disaffection, and the consequent withdrawal of his interests from the company, had an evident tendency to depress the price, but the report lacks sufficient foundation to be accepted generally. The preferred stock remains at the same quiet figure, 118¼, with very small sales. The bonds sell frequently at 104⅛. Westinghouse has passed the quietest week that it has known in a long time, but its good support holds it at about the same figures as during the previous week. Good parties all the time have their bid in for the stock and it does not lack a market when any is offered. The semi-annual dividend of 25 cents on Thomson-Houston Series D is payable Nov. 1. Its declaration had no apparent effect on the sales of this stock, which is always strong at about $8, which is a very good figure, though the book value would be nearer $11. A few sales of Detroit Electric are noted at 5. This recovers very slowly, and hardly at all, from the effect of passing the dividend. Bell Telephone is outside of the line of the specialties, for its price has defied the fluctuation of the railway stocks, and has been very strong at the high figure of 209. There has been very little activity in Erie and New England Telephone stocks, at prices unchanged from previous ones.

A recent large offer of electric railway bonds is that of the Metropolitan Street Railway Company, of Kansas City, Mo. The road operates in Kansas City, Mo., and Kansas City, Kan., reaching about 175,000 people. The company was organized in 1886, acquiring the property of two other companies, so that it operates the chief system in Kansas City. Its plant comprises 44 miles of track, of which the larger part is operated by cable and electricity. The aggregate cost of the property was $1,821,992. The total amount of bonds authorized and outstanding is $2,012,000. The gross earnings for year ending Jan. 1, 1892, were $675,501.35; operating expenses, $484,808.02; net earnings, $190,693.33; less interest charge on outstanding bonds, $100,720; surplus, net, $89,973.33. During the first eight months of 1892 the net earnings increased $54,846 over those of the same months in 1891. Estimating on a reasonable basis, the net surplus over and above operating expenses and interest charges for the year 1892 will be $147,888. The company's earning capacity is fully established. For two years it has paid stock dividends, and its earnings this year will be sufficient for a dividend of more than six per cent. The cost, as stated, is $4,821,992; the capital stock fully paid in is $2,793,400; bonds outstanding, $2,012,000; $395,000 of these bonds, bearing five per cent., and payable in gold, are offered, with a strong recommendation of their security value, at 97½ and accrued interest, by N. W. Harris & Co., of New York and Boston.

The Metropolitan Railway Company of Denver bonds are offered by E. H. Rollins & Son at 103 and interest. They offer $200,000 of an issue of $621,000, on a mortgage of $1,000,000. The company is leased to the Denver Tramway Company for 99 years, which latter company guarantees principal and interest on the bonds of the Metropolitan company. The net earnings for 1891 were $111,529, and for eight months in 1892, $111,818, which means for the year about $150,000 or an advance of 35 per cent. The tramway system has a mileage of 79 miles, and it is said that 70,000 people ride on the cars every day, on an average. The bonds bear the indorsement and recommendation for security and value of one of the foremost houses who offer them.

The preferred stock of the recently incorporated North Shore Traction Company was largely oversubscribed by parties in New York, Philadelphia & Boston. But as a privilege to old stockholders in the Lynn and Boston company $300,000 of this preferred stock was offered at par, with a bonus of 50 per cent. of common stock given. The capital of the company is divided into $4,000,000 common and $2,000,000 six per cent. cumulative preferred stock; the latter redeemable, on 30 days' notice, at 105.

BOSTON QUOTATIONS.

	Par.	Capitalization.	High-est.	Low-est.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	8¾	....	8¾	9
Thomson-Houston Elec.—Series D.....	sh	120,000	8⅛	7⅞	8	8½
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	....	....	10	12½
Westinghouse Elec.—New Com.	..	6,000,000	37½	36⅛	37	37½
Westinghouse Elec.—Pfd..	..	4,000,000	50	49	49½	50
General Electric.....	..	30,067,200	117¾	115	115¼	115½
" " Pfd ...		4,136,300	118½	118⅛	118	118½
Fort Wayne Elec.....	25	4,000,000	....	....	12½	12¾
Fort Wayne Elec.—Ser. A.	sh	80,000	8	....	7¾	8
Detroit Elec	10	750,000	5	....	5	5½
West End St. Ry. Co.—Com	50	7,150,000	72¾	72⅛	72¼	72⅝
West End St. Ry. Co.—Pfd	50	6,400,000	87¾	87	87¼	87½
American Bell Tel	100	15,000,000	209	207½	207	208
Erie Tel. & Tel. Co.....	..	4,800,000	47¼	47	46¾	47
Mexican Tel. Co.....	10	1,280,000	....	....	....	1.10
New Eng. Tel. & Tel. Co..	..	10,304,600	61	....	61	61½
Tropical Tel. Co.....	10	400,000	10c.	....	....	10c

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.
Chicago.....	215	....
Central Union	57¼	57½

Electrical Stocks:	Bid.	Ask'd.
Chicago Arc Light & Power Co.....	104	104⅜
Chicago Edison Co ...	165	..

NEW INCORPORATIONS.

The C. H. Lever Manufacturing Company, of Chicago, Ill., capital stock $10,000, has been formed to manufacture electrical and small woodwork. Chas. H. Lever, Amasa E. Mann and Reuben Wright are the promoters.

The North Shore Heat, Light and Power Company, of Chicago, Ill., capital stock $100,000, has been formed to manufacture and supply gas for fuel, light and power purposes, also electricity. John D. Cameron, James D. R. Graham and B. L. Gorich, are the incorporators.

The Columbia Manufacturing Company, of Seattle, Wash., capital stock $10,000, has been formed to deal in mechanical and electrical machinery and appliances, patents and patent rights. George Albert Kimball and Frank H. Osgood, of Seattle, Wash., are interested.

The Okanegan Investment Company, Leavenworth, Wash., capital stock $250.000, has been formed to lay out and construct towns, electric light plants, railways, etc. Chas F. Leavenworth, Albert Waddell, R. B. Hay and L. H. Bowman, of Olympia, Wash., are those interested.

The Pittston, Jenkins & Avoca Street Railway Company, of Pittston, Pa., capital stock $75,000, has been incorporated to construct and operate an electric railway in Luzerne county, Pa. Thos. English, C. F. Boban, Edward Barrett and A. B. Brown, all of Pittston, are the organizers.

The Citizen's Passenger Railway Company, of Pottstown Pa., capital stock $75,000, has been formed to construct and operate an electric railway from Douglasville to Pottstown. John P. Dunn, Pottstown; John C. Heilig, Reading, and W. Wilkins Carr, Philadelphia, are the promoters.

The San Bernardino Electric Company, of San Bernardino, Cal., capital stock $50,000, has been formed to erect and operate electric plants, etc. Peter Kehl, W. R. Porter, W. E. Van Slyke, all of San Bernardino, F. G. Cartwright and C. R. Lloyd, both of San Francisco, are the incorporators.

The Panora Electric Light and Power Company, of Panora, Ia., capital stock $6.000, has been incorporated to maintain and operate an electric light and power plant. G. M. Reynolds, A. W. McPherson, Lewis Hernot, C. M. Brumeler, and W. A. Yountz, all of Panora, Ia., are the incorporators.

The Norwich Insulated Wire Company, of Harrison, N. J., capital stock $375 000, has been formed to manufacture and sell insulated electrical wire and cables, etc. C. Newman, Bradford, England; C. J. Jackson, D. F. Manning, T. S. Quinn, T. C. Hoge, Brooklyn, N. Y.; W. J. Fanning, C. Backe and G. C. Devereux, New York city, are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 24, 1892.

Mr. F. E. Drake, of the Standard Electric Company, Chicago, Ill., was a visitor at our office this week. This company is crowded with orders for arc apparatus.

The Committee on Art of the Columbian Celebration has awarded to the Hotel de Logerot a gold medal for decorations installed by the Conduit Wiring Company, 12 West Twenty-ninth street, New York City.

Mr. G. P. Eltenberg, of Cincinnati, O., who is a representative in that territory of several of the large electrical companies,

made us a pleasant call this week. Mr. Eltenberg has already built up a trade that augurs well for the future.

Mr. B. F. Hamilton, purchasing agent for the Sawyer-Man Electric Company, and one of the most popular men engaged in electrical business in this city, was unanimously tendered the nomination for the Assembly by Tammany Hall in the 28th District. His many friends will regret that he thought best to decline the nomination.

W. S. Chesley & Co., electrical engineers and contractors, Electrical Exchange Building, 138 Liberty street, New York, have severed their connection with the Easton Electric Company, of Brooklyn, N. Y., and desire the agencies of electric light apparatus and appliances. This company has just completed a new machine shop at 21 Morris street, Jersey City, near the Cortlandt street ferry, and has facilities for repairing all kinds of electric light and power apparatus.

Mr. Max Luhn, engineer of the Helios company, Cologne Ehrenfeld, Germany, who, after an "information journey" in this country, returned to Europe on the 26th of October, on the "City of Paris," was very much pleased, not only with what he saw in the electrical field in America, but also with the kind reception he has everywhere received. Mr. Luhn asks us to thank, in his name, the different companies and the engineers whom he has met, for their kindness, and he invites them (if they should go to Germany) to call on him and inspect the factories of the Helios company.

ALBANY, Oct. 15, 1892.

James Shanahan has been elected president of the Fonda & Gloversville electric railroad.

The West Side Street Railroad Company, of Elmira, has opened offices in the Roe building on the corner of Water street and Railroad avenue.

Batavia is in an electric light muddle. The aldermen are endeavoring to construe the law so that they can substitute electricity for gas in lighting the streets.

The Common Council has granted a franchise to the Cayadutta Electric Railroad Company to run through Cayadutta, South Main, Burr and Beaver streets and through private lands from Burr street to Pine street.

Thomas Walsh, of the D., L. & W., is the new superintendent of telegraph lines on that road. It is reported that work will be commenced by the company to erect an entire new line of poles and wire between Binghamton and Buffalo. The old wires and poles will all be torn down.

A trial has been made on the Albany railway of a new street indicator. The new device is fitted inside of the motor cars and by an automatic arrangement the name of each street is displayed just before it is reached, and ample time given for passengers to see it and alight at the proper crossing.

The Rochester Railway Company will shortly have the Pinnacle avenue line in operation. Work is steadily progressing on the South avenue extension, which will be completed by the end of the week. As a particular protection against accidents the steps on the left hand side of the cars will be taken off.

The work of putting up poles and stringing wires for the electric light plant of the Ball Electric Light Company in the village of Hempstead has been commenced and is being pushed rapidly. The Ball Electric Light Company has the contract to light the streets with fifty 800 c. p. arc lights at $2,500 per year. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 22, 1892.

The Corliss Steam Engine Company, of Providence, is building a 500-h. p. cross compound condensing engine for the American Screw Company. The engine has a stroke of 4 feet, and its cylinders are 20 and 36 inches in diameter.

The Selma Photo. Electric Company has been organized at Kittery, Me., with $10,000, for the purpose of manufacturing electrical and photographic goods. The officers are: President, J. F. Iverson, of Boston; Treasurer, G. L. Reenstreina, of Boston.

The Brown & Sharpe Manufacturing Company, Providence, R. I., has received an order for several milling machines from the Metallic Drawing Roll Company, of Indian Orchard. Some of them will be used for the manufacture of rolls in England.

Thomas Lowry and others have filed articles of incorporation for the Commercial Telegraph and Electric Company, capital $1,000,000; indebtedness limited to $500,000. The company will ask for a franchise to operate in Minneapolis. The Dorset system of conduits will be used. The wires are to be strung under a new system and messages will be transmitted by means of new electric appliances, by which one wire takes the place of ten.

The Boston Society of Civil Engineers at a recent meeting decided to hire a room in the Wesleyan building on Bromfield street, Boston, Mass., for permanent headquarters. The following were elected to membership: Henry S. Adams, of Cambridge; Charles R. Felton, of Brockton, and Alfred Stebbins, of Boston. A paper was read by Geo. S. Rice, late chief engineer of the rapid transit commission, on "Rapid Transit for Boston." The views presented were practically those contained in the report of the commission. A discussion followed.

It is proposed to consolidate all the electric railway companies in the Connecticut Valley, with branches to the suburbs of each city. The consolidation would require a large amount of capital, and the system would demand careful management to be a paying thing, but the scheme is thought entirely feasible by men who have built and conducted electric roads. The amount of track needed to make the system complete is not large, probably less than 15 miles, and it would cost about $300,000 to lay the rails and equip the system. The cost of power stations would be considerable, but not too great to interfere with the success of the plans.

Ground has been broken for a new power house of the Lynn & Boston Street Railroad Company at the company's property on Mason street, and it is hoped to have the station in operation by April or May. The buildings will be substantially constructed of brick and the roofs of iron trusses. The boiler house will be 114 × 47 feet, and the engine house 114 × 60 feet. Both will be 20 feet to the eaves. The chimney will serve as a landmark all about that station. It will be of brick, square for 25 feet and then octagonal At the base the chimney will measure 17 feet square, tapering the top to 11 feet. The flue will be circular, eight feet diameter at the base, and nine feet at the top; total height, 160 feet. Total capacity in horse power, 3,000.

The Wells Memorial Institute for Working Men, 987 Washington street, Boston, Mass., has issued a prospectus for its free evening classes and Lowell free lecture courses, which commence the first week in November. Mr. Edmond Billings is superintendent of the institute and classes will be conducted in elementary mechanical drawing, advanced mechanical drawing and lectures will be given on electricity, steam and the steam engine building construction, elementary algebra and geometry, and kindred subjects. The lectures on electricity will consist of two courses of 15 lectures each, conducted by Mr. Wm. L. Puffer, of the Massachusetts Institute of Technology. The first course being intended for beginners and the second for more advanced students.

W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Oct. 22, 1892.

Mr. George Cutter, "The Rookery," Chicago, has secured the contract for supplying all the Simplex wire required in the Pennsylvania yards at Fourteenth street, in Chicago, where the Fort Wayne (Wood) arc light apparatus will be used.

The Chicago Electrical Association will hold its regular meeting on Tuesday, Oct. 25, at 8 P. M., in room 40, Athenæum building, 26 Van Buren street, when Mr. E. G. Hovey will read a paper on "Some Considerations Upon Storage Batteries."

Mr. George Preston Barton, of the well known law firm of Barton & Brown, of Chicago, was married at the residence of the bride's parents, in Towanda, Pa., to Miss Emma Welles, daughter of Mr. and Mrs. R. M. Welles, and sister of Mr. F. R. Welles, manager of the Bell Telephone Manufacturing Company, of Antwerp, Belgium, and of Arthur Welles, of New York City.

The Nubian Iron Enamel Company, of Cragin, Ill. (a Chicago suburb), is again favoring its friends with the very convenient quarterly desk calendar, which it sends out, and, in view of the approach of the closing months of the year, every one in the electrical and allied interest who desires a calendar both convenient and attractive should send their address on a postal card.

Among the World Fair's visitors from out of town this week were Mr. C. A. Daigh, vice-president and general manager; Mr. William E. Smith, auditor, and Mr. Carl Kammeyer, electrician of the National Electric Manufacturing Company, Eau Claire, Wis.; Mr. Clifford Holbrook, vice-president of the Canton Steel Roofing Company, Canton, O.; Mr. H. F. Leonard, manager of the Electrical Engineering & Supply Company, Syracuse, N. Y.; Mr. Wynn Meredith, electrical engineer of the Aurora Street Railway Company, Aurora, Ill.

Obituary.—Mr. George A. Harmount, formerly the Western representative of the New Haven Clock Company, and manager of the Monitor Electric Company, Chicago, died in New Haven, Conn., on Oct. 17. Mr. Ernest Speidel, a young chemist of great promise, died at his residence in Ravenswood, Ill., on Oct. 19. Mr. Speidel's services have been sought after by the electrical fraternity from time to time, as he was well known among them.

Mr. William D. Ray has severed his connection with the C. W. & N. P. R. R. Co., to accept a position with the C. & C. Electric Motor Company, 201 Madison street, Chicago. Together with Mr. H. L. Wills, he will install all motors and generators in the district covered by the Western office. The C. & C. Company reports very large sales during the month of September, and has just closed a contract for plants with the Harvest Steel Car Works and Fraser & Chalmers.

The Comptometer.—Felt & Tarrant, of Chicago, are in receipt of several communications from different electrical companies speaking in high terms of the value of their comptometer, which has proved so satisfactory an aid in their work, entirely removing the terrors of mental calculation and earning its cost price many times. Central station managers especially have found it valuable, and one writes, "It is especially desirable for long columns of figures, and we could not afford to be without it."

The electrical design of the American and Spanish flags over the Grant statue at St. Louis, Miss., designed and erected by the Emerson Manufacturing Company, has been reproduced in Chicago on the balcony of the Auditorium Building during the celebration of the World's Fair dedication. The Emerson Electric Manufacturing Company furnished the designs and structure for this piece, as well as the automatic cylinder operated by a ⅓-h. p. Merton alternating current motor, which produced the waving effects of the flags, so much admired in St. Louis.

Schuekert & Co., of Germany, recently sent over a powerful search light from Nuremberg for exhibition at the World's Fair. The test did not prove satisfactory on the grounds and it was decided to remove the lamp to the auditorium. This raised the question as to whether such action would be permitted by the customs authorities, and the Collector of Customs wrote to Washington for instructions. The reply was to the effect that goods removed from the Exposition Grounds were subject to the usual customs laws. The duty, amounting to upward of $300, was paid by the firm's representatives.

The Electro-Enamelite.—The American Electro-Enamelite Company, of Chicago, was recently incorporated with a capital stock of $200,000. The stock of this company is owned by some of most prominent men in the electrical field, both in the East and West, and two factories will be built, it is stated, one in Chicago and one in the East. The company was organized by Mr. George Cutter and will operate under the Morford patents, which were sustained by a recent decision of the Commissioner of Patents, as was stated in the last issue of THE ELECTRICAL WORLD. The invention consists in embedding conductors in an enamel and the application of this enamel to ordinary cooking vessels and heating apparatus. This device has proven practical and will, no doubt, come into more general use under the auspices of the new company.

Pluck and Enterprise.—Seven months ago the Electric Appliance Company opened its warerooms at 242 Madison street, Chicago, just at the close of a period that had proved an unusually severe one for electrical supply companies, owing to the heavy drop in copper wire, the loss resulting from depreciation in values of other lines of goods and the general stagnation in business circles. Much to the surprise of many of their competitors, the company made fair headway from the start and is now in receipt of a gratifying share of the trade that always follows square dealings. Winning friends from the start, through studying the interest of its customers, this company will close its first year with the names of nearly all the principal buyers on its list of customers. The success that has attended this young company is only another proof that an adherence to business principles will generally insure success.

F. DE L.

CANADIAN NOTES.

OTTAWA, Oct. 1.

Ottawa, Ont.—The City Passenger Railway Company, not having come to terms with the city corporation regarding the application of electricity as a motive power to its line, is purchasing a number of horses to replenish the stock of the road.

Ottawa, Ont.—Henry Smith, one of the contractors of the Cummings bridge, has placed a motor and electric wire at the coffer dam for the centre pier, and now does all the pumping by electricity. This is the first application of electricity to pumping in this part of the country.

Port Hope, Ont.—The light committee has reported that it is of the opinion that the town would be more efficiently lighted by a combination of electric arc and gas lamps, in the proportion of 15 of the former to 40 of the latter, which would give the electric company about $900 and the gas company $600 per year.

Outremont, Que.—A deputation from Outremont and Cote des Neiges has had an interview with the Hon. Mr. Beaubien, with reference to the proposed electric car service in their municipalities. They expressed themselves in favor of the scheme, and the Mayor of Cote des Neiges said that he would organize a committee similar to the one in Outremont. It is probable that in Cote des Neiges the railway will run on the new road east of the present thoroughfare.

Ottawa, Ont.—The Minister of Inland Revenue is now preparing a bill providing for government inspection of electric lights in Canada, which will be introduced at the next session of Parliament. It will be remembered that at the last session the Minister of Inland Revenue indicated that either he would drop gas inspection altogether or bring electric lighting under a system of inspection as well. Since then he has determined to recommend the latter plan, and accordingly has engaged the services of an electric expert, Mr. O. Higman, who has been for some time acting with the officials of the department devising a scheme of inspection. Meantime the Minister is at work upon the bill that will empower the department to carry out the proposed scheme. It is not likely that any fixed standard in strength or quality of light will be insisted upon in the proposed regulations, but the design will be to devise a system of inspection that will determine the extent to which electric light companies carry out their contracts with corporations and other consumers. It has long been a source of complaint on the part of gas companies that gas is liable to inspection while electric light is exempt.

Port Arthur, Ont.—The question of the right of Port Arthur to extend its present electric street railway into and through the town of Fort William came up finally for discussion before Hon. Mr. Gibson, Provincial Secretary. It is understood that an agreement has been reached which provides that the people of Fort William West will have a railway in full operation by next autumn. The whole length of the line as determined upon will be eight miles, and a certain number of cars will run continuously from one end to the other every day. Certain provisions were made as to Fort William taking a joint ownership if it so elects, and certain protective clauses were put in guarding Port Arthur's interests in the event of the portion of the road within the limits of Fort William being taken over by the latter municipality. Port Arthur is to have the right to run the road for 20 years from Dec. 1, 1893. At the end of that time Fort William may buy the property of the railway which lies within its own limits at a valuation to be settled by arbitrators. The railway plant and property are not to be taxed by the council of Fort William. Until Fort William pays for an interest in the road, the road is to be managed by the council of Port Arthur, who shall be entitled to the whole income derived from the railway.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Oct. 12, 1892.

Electric Lighting of the City.—The 400 arc lights contracted for by the City of London Electric Lighting Company have now been, with a few exceptions, in operation for some weeks, and there can be but little doubt that they give on the whole unqualified satisfaction. The street lighting, which now remains to be done will be carried out entirely by means of incandescent lamps; the streets being in most cases exceedingly narrow, with high warehouses and other similar buildings on either side. At the last meeting of the Corporation Committee charged with matters connected with the streets of the city, an application was made by the City of London Electric Lighting Company for permission to use some of its pipes for telephonic cables. This application gave rise to an animated discussion. The committee was reminded that it was less than a year ago that they had refused permission to an old established company like the National Telephone Company to run its wires underground and several members considered it exceedingly unbecoming of the electric light company to have stolen a march on the committee and to have laid pipes for telephone purposes without the knowledge or consent of the corporation, and there was a general consensus of opinion that no such application should be entertained until the company had carried out its contract for public and private lighting in its entirety. Ultimately the communication of the company was referred for consideration to a sub-committee.

Electric Lighting at Wigan.—The Town Council of Wigan report that a recent circular sent out by them, with a view of eliciting information as to the probable number of users of the electric light, has only resulted in eight favorable replies. This meagre response has enabled the Town Council to shelve the question, which, as they own the gas works, is probably what they were desirous of doing from the beginning. Municipal circulars of this kind usually begin with a statement somewhat as follows: "Assuming that the cost of the electric light will be three times that of gas, are you likely to make use of it?"

Naval Signaling.—A lengthy and somewhat acrimonious discussion has lately been occupying the columns of the electrical press with regard to the relative merits of different modes of signaling in the navy. For ordinary day purposes between ships of a squadron there seems to be a general consensus of opinion in favor of the semaphore. At night, however, in spite of various ingenious arrangements for illuminating the arms, the semaphore is out of the question and the flashing system with the Morse code is employed. For long distance flash signaling in the day time, the heliograph is used and the rays of the projector are thrown on the sky at night for the same purpose. It would seem, therefore, that one or the other of these methods must meet all the requirements of the navy. The ingenious inventor, however, is not to be so easily put off, and lately a Mr. C. E Kelway has succeeded in obtaining several press notices of a cumbersome system devised by him, which consists in hoisting in mid air a framework of incandescent lamps, forming the letters of the alphabet, each letter to be illuminated when required from the deck by means of a key. A naval officer of considerable experience has ventured to expose the weak points of the Kelway system and as a natural consequence has drawn down upon himself the wrath of the angry inventor.

News of the Week.

THE ELECTRIC LIGHT.

Rice Lake, Wis., will soon have electric lights.

New Carlisle, O., is to be lighted by electricity.

Prinville, Ore., is soon to be electrically illuminated.

Ilwaco, Ore., is to light its streets by electricity in the near future.

Rockville, Mass., is to hold a special meeting Nov. 15 to pass upon an appropriation of $25,000 for electric street lighting.

The Monson and Palmer (Mass.) Electric Light Company has decided to locate a plant on the Monson side of the river.

Glen Rock, Pa., at a recent special election, decided in favor of contracting with the Norrish company for 32-c. p. incandescent lights for the illumination of its streets.

The Edgerton Electric Light Company has closed a contract with a Jaynesville company to furnish current, and the city of Edgerton, Wis., will be lighted by electricity after Jan. 1.

Will Ignore Unions.—Twenty-one of the leading electric light companies of New York, Brooklyn and vicinity have given notice that they will hire union and non-union men on exactly the same terms.

Toledo (O.) underwriters have concluded that they need an inspector to examine the electric light risks of the city and the various companies have been asked to contribute enough to pay the salary of a competent man.

Mr. Charles G. Wells has been appointed electrician for the Elkton Electric Light and Power Company, of Elkton, Md. This company is installing a new Thomson-Houston alternating current plant, the contract having been placed with the Pennsylvania General Electric Company for a 1,000 light incandescent machine, a 100-h. p. boiler and an 80-h. p. engine, and a brick power house.

THE ELECTRIC RAILWAY.

Wilkesbarre, Pa.—Work has begun on the new power house for the local traction company.

Geneva, N. Y.—The electric plant is to be enlarged to furnish power for an electric street railway now under construction.

The Shamokin and Mt. Carmel (Pa.) Electric Railway Company has been capitalized for $100,000, and the Beaver Meadow, Hazleton, Mahony & Shenandoah Electric Railway Company at $150,000, and both companies will undertake the construction of roads in the near future.

The West End Street Railway Company, of Rockford, Ill., has operated its line for a period of 16 months, during which time it has transported 324,867 passengers without an injury of any kind to any individual, or the presentation of a claim for damages, either to person or property. This is a remarkable record.

Montgomery, Ala.—The West End, Riverside & Electric Street Railway is now considered a certainty. The cars, track, power station, etc., have been contracted for. A site for the plant between North Court and Perry streets has been purchased. The Westinghouse system will be used. The estimated cost is between $75,000 and $100,000.

The Quincy & Boston Street Railway Company held its annual meeting on Wednesday, Oct. 19, and elected the following officers: President John R. Graham; Secretary and Treasurer, Fred. H. Smith; Directors, John R. Graham, John A. Duggan, John F. Merrill, Winthrop Coffin, Roger H. Wilde, William A. Hodges, Josiah Quincy, Thomas H. McDonnell and Arthur Burnham. The report of the treasurer showed the number of passengers carried this year to have been 85,000 more than during the previous year; the miles of track have been increased to nine, and the cash surplus now on hand is $13,000.

The Washington (D. C.) & Arlington Railway Company has completed its electric road and cars are now running regularly over the line. The construction of the road is under considerable difficulty, as there was one cut 20 feet deep and over 200 feet long, and one trestle 32 feet high and 250 feet long, besides places which had to be filled in to the depth of 18 feet, aggregating over 500 feet in length. The power house is located in Georgetown and the wires are suspended from the aqueduct bridge. From M street, between Thirty-second and Thirty-third streets, a line of hacks runs to the electric cars with a five cent fare.

The Directors of the District of Columbia Suburban Railroad held a meeting in Washington last week and decided that work on the new line would be undertaken immediately. The route is along the Bladensburg road from the district line by way of Eighth, Seventh, G streets, N. E.; First street and Jersey avenue, G and Fifth streets, Louisiana avenue to Seventh street, N. W., to the centre of the city. That portion of the line outside the boundary of the city will in all probability be operated by the trolley system, while the part within the city limits will of necessity be operated either by the storage battery or the conduit system, probably the latter. The entire road will be some 13 miles in length, mostly double track, and will open up for suburban residences a valuable section of the District.

LEGAL NOTES.

Must Use Metallic Circuits.—The New York Court of Appeals has handed down a decision in the case of the Hudson River Telephone Company vs. The Waterville Turnpike Company. The real parties to the action were the Bell Telephone Company and the Edison General Electric Company. By the decision the Bell Telephone Company is obliged to build metallic circuits at a considerable increased expense.

Liability for Foreman Setting a Boy at a Hazardous Employment.—As a general rule a person entering into the employ of another is held to assume the ordinary risks incident to the service, including the risk of injury occasioned by the negligence of a fellow servant; but if a boy 15 years of age is engaged to work for his employer in a non-hazardous service, and is placed by the employer under the control of a foreman or gang boss, and such foreman orders him to do a thing in its nature hazardous to life or limb, and outside of the duties of the boy, but within the scope of the employment and duties of the foreman and in the attempt to perform such act the boy is thereby injured or killed, then the giving of such order by the foreman is negligence, and the negligence of the foreman would be the negligence of the employer. This decision was rendered in the case of Orman vs. Mannix, in the Supreme Court of Colorado.

Duty of Employers in Hiring Servants and Furnishing Machinery.—It is the duty of an employer to select and retain servants who are fitted and competent for the service, and to furnish sufficient and safe materials, machinery, or other means by which it is to be performed, and to keep them in repair and order. This duty cannot be delegated to a servant so as to exempt himself from liability for injuries caused to another servant by its omission. Indeed, no duty required of him for the safety and protection of his servants can be transferred so as to exonerate him from such liability. The servant does not undertake to incur the risks arising from the want of sufficient and skillful co-laborers, or from defective machinery or other instruments with which he is to work. His contract implies that in regard to these matters his employer will make adequate provision that no danger shall ensue to him. This decision was rendered in the Northern Pacific Railway Company vs. Charless, in the U. S. Circuit Court of Appeals, Ninth Circuit

MISCELLANEOUS NOTES.

The Standard Paint Company, Bound Brook, N. J., has issued invitations to a house warming at its newly completed buildings on Monday evening, Oct. 24, 1892.

The National Brotherhood of Electrical Workers of America, of Kansas City, Mo., is issuing invitations for its annual ball for the benefit of a relief fund for Local Union, No. 18, to be held Nov. 2, 1892.

Honors to an Electrician.—Mr. James Sivewright, joint author with Mr. W. H. Preece of a well-known manual of telegraphy has recently been made a knight commander of the order of St. Michael and St. George.

Mr. Julius Lefmann, of St. Louis, Mo., was unable to be present at the Street Railway Convention at Cleveland on account of severe injuries received in an accident which happened at Denver, Colo., during the recent Knights Templar conclave in that city.

The Electrical Power Storage Company, Limited, 4 Great Winchester street, London, E. C., England, is sending out a circular stating that it is prepared to negotiate for the working and maintenance of approved tram lines equipped with self-contained or storage battery cars.

All Southerners engaged in electrical business in the Middle, Western and Northeastern States are requested to send their names and addresses to G. Wilfred Pearce, president of the New Jersey Southern Association, New Brunswick, N. J. It is the desire of that society to ascertain how many men born or bred south of Mason and Dixon's line are now at work in the electrical field.

Bath, Me.—A number of the most prominent capitalists of Bath recently held a meeting to consider the plan proposed to secure the water privilege on the Androscoggin River about 14 miles from Bath and to construct there a dam to develop power which might be transmitted to the city and used for manufacturing purposes. Five thousand horse-power can easily be developed while the entire power available is much larger. It was estimated that the entire outlay would cost about $150,000.

College Extension.—A course of ten lectures on electricity is to be given at Hull House, Polk and Halsted streets. Hull House is modeled after Toynbee Hall, London, and its object is to give educational advantages to the poorer districts of the city. The instructors give their services without remuneration, and a small fee of $1 for the ten lectures is charged so as to avoid any appearance of a charity organization. Lectures on the fundamental principles of the science of electricity will be given by L. K. Comstock, Ph. B., of the University of Michigan, and on experimental investigation in applied electricity by Edward Shaw, E. E., of the Boston Institute of Technology. The course in physics will be under the charge of Thos. G. Greer, M. E., University of Pennsylvania.

The Corcoran Scientific School, of the Columbian University, Washington, D. C., has issued its prospectus of courses leading to the degree of electrical engineer for 1892-93. Francis R. Fava, professor of civil engineering, has charge of this department. The course is four years in extent and includes all the subjects taught at the advanced engineering schools of the country. Considerable attention is given to the theoretical treatment of electricity, involving a knowledge of advanced mathematics during the third and fourth years, but the practical side is studied as well and opportunities given for laboratory work and the inspection of electrical plants. Students in this class have also the advantages of the courses in physics and civil engineering as well as in the department of mathematics.

Industrial and Trade Notes.

The F. Holman Company, of 128 Pearl street, New York, report business in their Paragon reflectors as being very brisk.

The Union Electric Company, of 45 Broadway, New York, has secured the contract for furnishing the storage batteries to be used on the Metropolitan Street Railway, at Washington, D. C. The number of cells used is to be 5,000.

The Backus Water Motor Company, of Newark, N. J., has installed electric motors at R. H. Macy's for ventilating and also in the Pennsylvania Railroad depot at Jersey City. The company manufactures motors and exhaust fans.

The Columbian Metallic Rod Packing Company has recently commenced the manufacture of a patent automatic metallic packing, which is bound to become very popular, as is evidenced by the numerous orders recently received.

The Jackson & Woodin Manufacturing Company, of Berwick, Pa., has placed the contract for a new car wheel foundry with the Berlin Iron Bridge Company, East Berlin, Conn. The building will be from the designs of the Berlin company and entirely of iron.

The Mather Electric Company, 97 Nassau street, New York City, during the last week has placed the following orders: One 15-h. p. motor, Jennings Lace Works, Brooklyn, N. Y.; one 3 h. p. motor, Thomas F. Larkin, New York; one 1-h. p. motor, J. P. Hoeckar, Brooklyn, N. Y.

The Malcolm Mills Company, of Frankford, Pa., makes a specialty of manufacturing cotton yarns for insulating wire of all kinds for electrical purposes. C. M. McLeod & Co., 216 Chestnut street, Philadelphia, is the sole agent for these yarns, and is particularly desirous of receiving a portion of the electrical trade. These yarns are said to be equal to the best in the market.

The Carpenter Enamel Rheostat Company, of Bridgeport, Conn., has quite recently finished doubling their furnace capacity. It is running its works night and day with this enlarged capacity. These rheostats seem to meet with universal approval from the electrical manufacturers and engineers. The theatre and street car rheostats seem to be especially appreciated.

The Pennsylvania Machine Company, of Philadelphia, is now shipping, via the Pacific Mail Steamship Company, from New York City, a 60-h. p. stationary engine, and a 60-h. p. horizontal tubular boiler of locomotive type, to Nicaragua. This steam plant is to be used for power purposes on a coffee plantation at that place. It is complete in all particulars and ready to set on foundation and run on arrival.

A Reliable Pressure Indicator.—One of the most important pieces of apparatus in a central station, and more especially in an isolated plant, is a good pressure indicator. It is as essential to a 50-light arc dynamo as a steam gauge is to a boiler. The Wirt volt indicator, made by the Electrical Supply Company, corner Randolph street and Michigan avenue, Chicago, Ill., is a very excellent instrument, and the manufacturers report that they are daily in receipt of letters expressing satisfaction with their use.

The Campbell & Zell Company, of Baltimore, Md., has just been awarded the contract for 1,700 h. p. Zell improved water tube safety boilers for the electric light plant at the Auditorium Hotel at Chicago, which will be the largest isolated electric lighting station in the United States. The company has also recently closed contracts for a number of smaller plants, including a 50-h. p. high pressure boiler for the Mechanical Department of the Delaware College at Newark, Del., and one 75-h. p. boiler for Messrs. D. Klotz & Co., New Orleans, La.

Maris & Beckley, successors to the Maris Machine Company, 2,343 and 2,345 Callowhill street, Philadelphia, found it necessary to enlarge their plant and increase their capital on account of the growth of their business. They ascribe this increase to three causes—first, excellence of product and strict attention to business, second, a general increase of demand for goods in their line; third judicious advertising, for which THE ELECTRICAL WORLD is entitled to a fair share of credit. The works are now running day and night in order to keep up with the orders. The capacity of the plant is to be trebled in a few months.

Partrick & Carter Company, 125 South Second street, Philadelphia, Pa., have issued a handsome new catalogue containing illustrated descriptions of the numerous articles manufactured and handled by them, including bells, burglar alarms, batteries, carbons, cables, electroplating and electro-medical apparatus, fire-alarm boxes, gas lighting outfits, insulators, magnets, various styles of push buttons, tools, wire, etc. One of the articles they make a specialty of is the patent needle annunciator, which was described in THE ELECTRICAL WORLD of Oct. 1, 1892.

The B. F. Sturtevant Company, Boston, Mass., is installing a large fan for improving the ventilation of the Provident Institution for Savings, Providence, R. I., which will be driven by an electric motor. The Sturtevant system is being installed in the shops of the Siemens & Halske Electric Company of America, at Chicago, and the Bryant Electric Company, at Bridgeport, Conn., and the new works of Fraser & Chalmers, at Chicago, are being supplied with the Sturtevant blower, heating and ventilating system, the five immense fans being driven by electric motors.

The Mosher Electric Company of Chicago, successor to the Arc Lamp Co., has been meeting with such success since its reorganization that it has found it difficult to keep up with its incoming orders. The lamp has recently been improved and is giving excellent satisfaction. The sales, it is reported, are four times as great as they were last year for the corresponding period, and are constantly increasing. It is proposed to manufacture at an early date the Mosher dynamo motor, and complete lighting and power system. Mr. J. A. Sheriffs is the secretary and manager of the company, as well as the secretary of the Chicago Nickel Works, and is a capable financier and business man. Mr. Mosher is the vice-president and has charge of the shop, while Mr. G. L. Reimann is president as well as presiding officer of the Chicago Nickel Works.

Enamel Rheostats.—The latest development in the line of enamel insulation is the issuance of a patent, under date of Aug. 30, 1892, No. 481,781, broadly claiming the fundamental features of enamel rheostats. The patent is issued to Charles E. Carpenter and is assigned to the Carpenter Enamel Rheostat Company, of Bridgeport, Conn. The patent was applied for upon Feb. 18, 1891. The Carpenter Enamel Rheostat Company states that the recent decision of the Commissioner of Patents awarding priority to Morford for a similar invention for electric heaters has no bearing on rheostats, as the specification and the claim in Morford's patent is limited to "electro-heating apparatus." The issuance of the present rheostat patent so soon after the Commissioner's decision would seem to remove all doubt as to the independence of the inventions.

J. E. Rhoads & Sons, manufacturers of oak tanned leather belting, and dealers in lace leather, rubber belting and hoses, 229 Market street, Philadelphia, have been very busy at their factory recently filling the large orders which they have on hand. This business was started in a small way by Rhoads & McComb in 1887, in connection with the finishing of heavy leather. The belting plant has increased from time to time until in the fall of 1887 they were succeeded by J. E. Rhoads & Sons, who have since devoted their attention very largely to the perfecting of their belting factory. The efficiency and capacity of the plant have been greatly increased by additions and improvements, and by changes in methods of manufacture. This company tans its own leather, and great care is taken in the selection of the leather for the various purposes, as well as in its preparation, which results in belts of the very best quality.

Value of Graphite for Electrical Work.—If, for example a stick of graphite is made six inches long and one-quarter inch in diameter, it can be so made that it will possess an electrical resistance of one ohm or one thousand ohms. Furthermore if such a stick of one thousand ohms is cut in two pieces each length will be found to possess a resistance of five hundred ohms. This homogeneousness of the mass enables the electrician to easily solve some difficult problems that would otherwise call for expensive appliances. For telephone switch boards and other uses where the current is not great, and where the resistance is variable on account of induction from near by trolley wires or other causes, graphite resistance rods have been found very valuable. Graphite resistance has been successfully introduced in sockets intended for regulating the light of incandescent lamps, and as the graphite can be formed in many different shapes as well as in varying resistances the field is a very promising one. The Joseph Dixon Crucible Company, of Jersey City, N. J., has already filled many orders for such material.

The American Silk Manufacturing Company, formerly of St. Louis, Mo., but now located at 311 Walnut street, Philadelphia, makes a specialty of manufacturing machine wiping towels of silk waste in six different standard sizes. These towels answer the same purpose as cotton waste, rags, flitter, hemp, etc., and are said to be very much superior. They are soft, and not spontaneously combustible as rags and waste are, and are at least 75 per cent. cheaper; besides the work which these towels, or wipers, are employed upon can be done much quicker and better. There are many purposes for which this class of wipers could be used to great advantage about railroad machinery, dynamos, commutators, etc. These towels are becoming very popular, which is quite apparent from the fact that the following companies are users: Edison Electric Light Company, Philadelphia; Jacksonville Electric Light Company Florida; Fergus Falls Gas and Electric Company, Minnesota; Laclede Gas Light Company, St. Louis, Mo.; Manhattan Electric Light Company, Limited, New York; Allison Manufacturing Company, Philadelphia; Pennsylvania Iron Works, Philadelphia; Malleable Iron Works, Philadelphia, and Wabash Railway Company, Moberly, Mo.

The Ball Engine Company, of Erie, Pa., report the following list of recent sales: Equitable Building, Baltimore, Md. 35-h. p., 80-h. p. and 130-h. p. engine; Coulee City Electric Light Company, Coulee City, Wash., 25-h. p.; Rock Cut Clay Company, Alfred Centre, N. Y., 60-h. p.; Englewood Electric Light Company, Englewood, Ill., 600-h. p. Cross compound; Port Huron Electric Railway Company, Port Huron, Mich., 450-h. p. Cross compound; Solomon & Ruben, Pittsburgh, Pa., two 80-h. p.; Royal Light, Heat and Power Company, Front Royal, Va., 100 h. p. engine and complete steam plant; Brokaw Bros., New York City, 70-h. p., and two 130-h. p.; Borough of Sharpsburgh, Sharpsburgh, Pa., 100-h. p.; Brooks & Co., Guantanamo, Cuba, 35 h. p.; Hotel Rennert, Baltimore, Md., two 80-h. p.; Buffalo Board of Trade, Buffalo, N. Y., 35-h. p.; Commercial Electric Light Company, Columbus, Ind., 150-h. p. engine and complete steam plant; W. G. Metzerott & Co., Washington, D. C., 60-h. p.; Baltimore Sugar Refining Company, Baltimore, Md., two 100-h. p.; City of Jackson, Jackson, O., 100-h. p.; Connellsville Coke Company, Connellsville, Pa., 25-h. p.; Chas. Furst, Jersey City, N. J., 60-h. p.; Lake Superior Hotel Sanitorium Company, Marquette, Mich., 50-h. p.; Wilmington Gas Light Company, Wilmington, N. C., 150-h. p.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A World Beater.—We have downed the Perfection Oil Purifier, of New York, and the Phœnix Oil Filter, of Racine, Wis., in competitive tests with our Automatic Ideal Steam Oil Refiner. Send for catalogue to Purity Oil Filter Manufacturing Company, 900 Water street, Pittsburgh, Pa.

Where to Locate New Factories is the title of a 150 page pamphlet recently published by the Passenger Department of the Illinois Central Railroad, and should be read by every mechanic, capitalist and manufacturer. It describes in detail the manufacturing advantages of the principal cities and towns on the line of the Southern Division of the Illinois Central and the Louisville, New Orleans & Texas railroads, and indicates the character and amount of substantial aid each city or town is willing to contribute. It furnishes conclusive proof that the South possesses advantages for the establishment of every kind of factory working wool, cotton, wood or clay. For a free copy of this illustrated pamphlet address Mr. J. Merry, Assistant General Passenger Agent I. C. R. R., Manchester, Ia.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

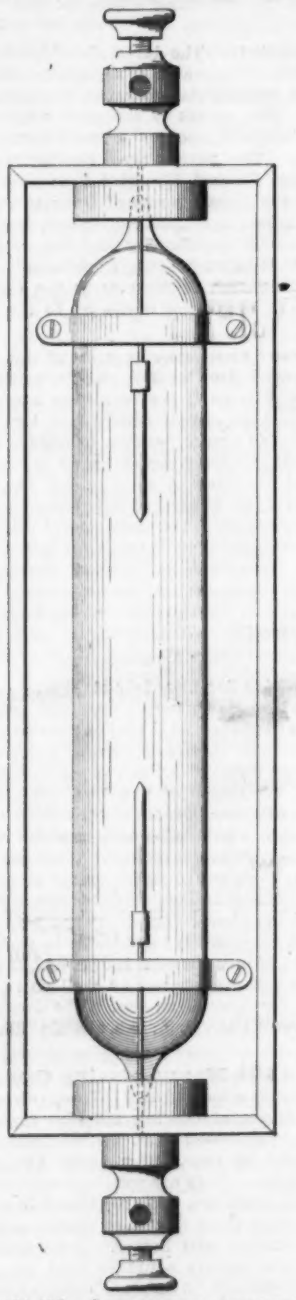
[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED OCT. 18, 1892.

484,386. Electric Fire-Alarm; Joaquin José D'Almeida and José Ygnacio Da Silva, Lisbon, Portugal. Application filed May 2, 1890. An electric alarm comprising a vessel containing an exciting liquid and the electrodes of a galvanic cell out of contact with the exciting liquid, the whole arrangement being such that upon a predetermined rise of heat the exciting liquid will contact with the electrodes.

484,450. Electric Light Fixture; Daniel S. Page, Malden, Mass. Application filed Dec. 12, 1891. The combination, with a rimmed or flanged metallic plate adapted to support an incandescent electric lamp, and a transparent cup or cover removably secured thereto, of a base or block to which the plate is attached, and between which and the plate is formed an air space or chamber, the outer wall of which between the plate and base or block is provided with transverse openings communicating with the air space or chamber, to afford a circulation of air behind the lamp-supporting plate.

484,466. Lightning Arrester; Lewis Searing, Denver, Colo. Application filed Jan. 20, 1892. A lightning arrester or safety device for permitting the discharge of lightning or like static charges of high tension, and for rupturing the arc formed when the discharge has passed, consisting of a pair of electrodes inclosed in a tube or reservoir containing a non-striking vacuum. (See illustration.)



No. 484,466.—Lightning Arrester.

484,469. Fusible Fire-Alarm; George B. Smith, St. Cloud Minn. Application filed May 10, 1892. In an electric thermostat, the combination of a non-conductor base block, a metallic cover having non-metallic fusible insulating material secured to the bottom thereof, two springs pressing against the material and having wires attached to the springs, and a wire connected to and in contact with the cover.

484,479. Electric Lighting System; Barton B. Ward, New York. Application filed March 1, 1892. The combination, with electric arc lamps run in series on constant potential mains, and each having a main and a derived circuit magnet with a movable core, of a mass of iron opposite the ends of the cores for both magnets in each lamp of the series.

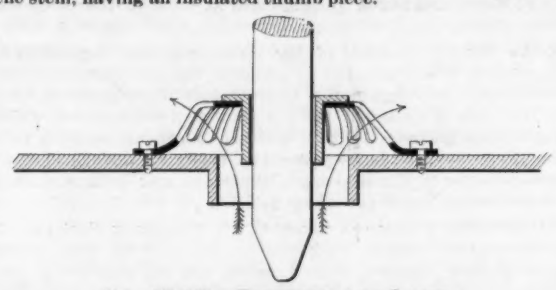
491,480. Hanger Board for Electric Arc Lamps; Barton B. Ward, New York. Application filed April 30, 1892. A metal plate having a hollow resistance frame supported beneath it and supporting devices for the lamp, extending down from the plate through the hollow resisting frame.

484,483. Insulating Joint; Charles Wirt, Chicago, Ill. Application filed Aug. 29, 1891. The combination of an insulating shell or plug in one piece, an inclosing non-interlocking shell also in one piece and an insulating filling between the two, hardened in position and adapted to secure the parts together without further labor than the proper placement, the exterior shell and connecting piece made non-interlocking and adapted to be retained in their relative positions solely by help of the inserted or interposed insulation.

484,522. Electrode for Medicinal Purposes; Edward H. McBride, Springfield, Mo. Application filed July 21, 1892. In an electrode, the combination with a non-conducting casing provided at one end with an annular flange, of an electrical conducting disc carried by this casing and located beneath the flange, and a soft rubber washer interposed between this flange and disc and projecting beyond the latter.

480,530. Electric Arc Lamp; Carl Coerper, Coeln, Germany. Application filed June, 1892. In an electric lamp, the combination with a reflector having an opening of a slotted piece secured on the reflector over the opening, and a guide collar on the slotted piece. (See illustration.)

484,532. Electrical Curling Iron; Andrew D. Gardner, Lynn, Mass. Application filed Oct. 21, 1891. In a curling iron, the combination with an insulated handle of a hollow metallic curling stem, electrical conductors in the handle, a looped resistance wire within the stem, having its respective branches coiled parallel with each other and connected to the conductors, and a jaw on the stem, having an insulated thumb piece.



No. 484,530.—Electric Arc Lamp.

484,543. Electrical Inductorium; Lazarus Simon Magnus Pyke and Harry Theodore Barnett, London, England. Application filed Feb. 5, 1892. The combination, with an electrical inductorium whose wires are mechanically insulated or separated by permeable material, of a dehydrated liquid hydrocarbon contained in a vessel surrounding the inductorium, and means for maintaining a continuous flow of the liquid hydrocarbon from, to, and in the vessel.

484,544. Electrical Inductorium; Lazarus Simon Magnus Pyke and Edward Stephen Harris, London, England. Application filed Feb. 5, 1892. In an electrical inductorium, the combination with an annular coil and with U-shaped plates interleaved with porous insulating material and applied alternately to opposite ends of the coil and bolted together in groups, a containing vessel having vertical grooves on its dies, in which the groups of plates are held. (See illustration.)

484,545. Electric Fuse Box; William Stanley, Jr., and John H. Kelman, Pittsfield, Mass. Application filed Dec. 21, 1891. A detachable incombustible fuse-carrier having upon one of its faces metallic terminals to which the ends of the fuse are attached, pins or studs electrically continuous with the terminals, projecting from its opposite face, and metallic spring-clips affixed to an incombustible inclosing case and adapted to receive and make electrical contact with the pins.

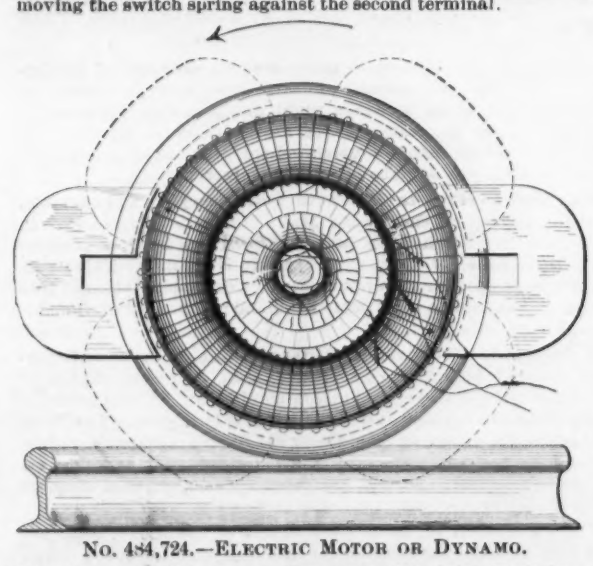
484,549. System of Electrical Distribution; De Witt B Brace, Lincoln, Neb. Application filed Sept. 16, 1891. In a system of electrical distribution, the combination, with a single pair of main conductors, of a generator of periodic currents and translating devices, actuated by such currents included in separate parallel branches between the main conductors, and electrolytic condenser offering a higher resistance to continuous than to periodic currents included in each of the branches, a generator of continuous currents and a translating device actuated by such currents, each included in a separate parallel branch between the same main conductors, and an inductor included in each of the said branches, which offers a higher resistance to periodic than to continuous currents.

484,549. System of Electrical Distribution; De Witt B. Brace, Lincoln, Neb. Application filed Sept. 16, 1891. A system of simultaneously transmitting periodic and continuous currents, which consists in generating periodic currents in one branch and continuous currents in another branch of a given circuit and in causing the same to be superposed in the undivided portion of the circuit by rendering the first branch opaque to continuous and the second branch opaque to periodic currents.

484,574. Electrically Heated Hand-Stamp; John Barney Venker, St. Louis, Mo. Application filed December 11, 1891. As an improvement in hand-stamps, the combination, with a base or backing plate and a contact plate carried thereby, of electrical resistance located at the back of the contact-plate, and insulated from the base or backing-plate, and inwardly projecting pins or studs located between the plates and adapted to retain the latter in their proper relative positions.

484,577. Combination Lock and Alarm; Robert Baumann, St. Louis, Mo. Application filed Aug. 20, 1891. The combination, with a sliding drawer, of a battery and bell contained therein and electrical connections adapted to automatically close the circuit when the drawer is slid from its normal position.

484,580. Lamp-Socket and Circuit-Closer Therefor; Sigmund Bergmann, New York. Application filed May 18, 1892. The combination, in a socket, of an insulating body, on one end of which are two springs, one of which forms, or is connected to the central contact of terminal of the socket, the other of which is a switchspring, a second socket contact or terminal supported in proper relation to the first mentioned terminal, and means for moving the switch spring against the second terminal.



No. 484,724.—Electric Motor or Dynamo.

484,611. Regulator for Dynamo-Electric Machines; Charles E. Scribner, Chicago, Ill. Application filed May 5, 1890. The combination, with the shaft of the revolving armature of a dynamo-electric machine of a mechanical device in engagement therewith and connected with the brush carrier and an armature controlled by the magnetic force of the armature shaft, the armature being connected with a device for controlling the action of the step-by-step acting mechanism upon the brush carrier to maintain the current strength.

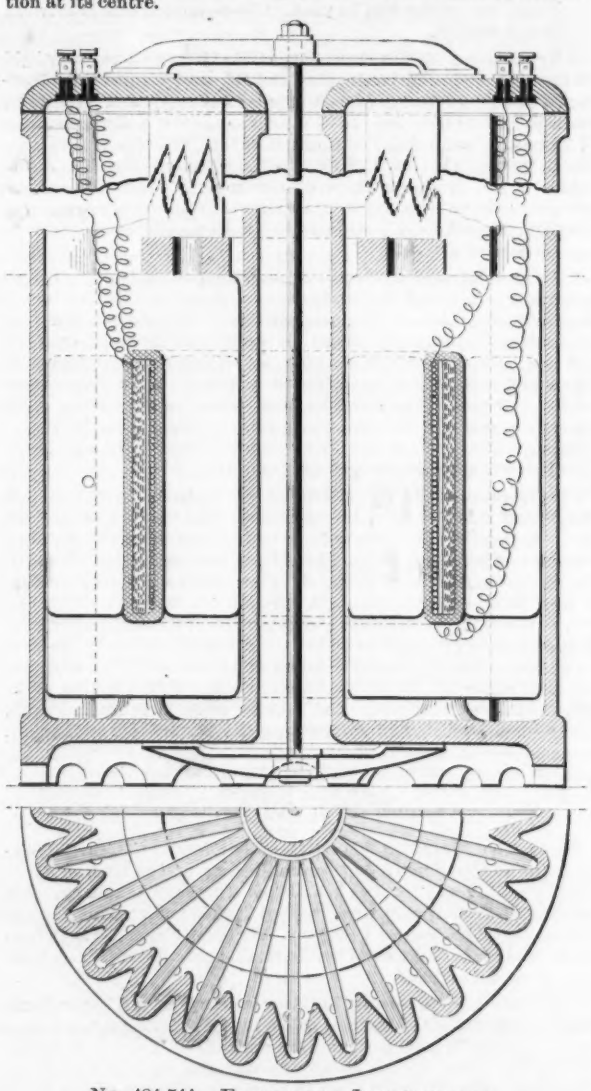
484,612. Multiple Switchboard System; Charle E. Scribner, Chicago, Ill. Application filed Jan. 21, 1892. A telephone line connected with an individual annunciator at the central office in two branches or limbs, each branch or limb including a different differential winding of the individual annunciator, whereby current sent over one limb will operate the annunciator, while current sent over both limbs will render the individual annunciator neutral and prevent the operation thereof.

484,613. Sub-Station Apparatus for Telephone Systems; Charles E. Scribner, Chicago, Ill. Application filed Jan. 21, 1892. The combination, with a telephone line extending to a sub-station of a telephone and signal receiving device in separate permanently closed parallel branches between the two sides of the line, the signal receiving device being of high retardation.

484,514. Electrical Railway Signal; Benjamin Caplin Seaton, Nashville, Tenn. Application filed March 1, 1892. In an electrical railroad signal, the combination with the railroad bed of the supports or bracket thereon, the conductor formed of the strips supported on the brackets and insulated from each other, the electric generator, and magnetic signal, and switch electrically connected with the conductor, the vertical rod carried by the car, the shoe carried by the rod for engaging the conductor, and the wire leading from the shoe to the brake-shoe of the car, whereby a circuit may be formed through the conductor and wheels of the car to sound the signal.

484,618. Electric Appliance for Canes; Stephen D. Smith, Milwaukee, Wis. Application filed Dec 7, 1891. The combination, with a cane or analogous article, of a suitable source of electric current, wires leading from opposite poles to the roof, a current-interrupter connected with the wires, metallic portions located at suitable points upon the outside of the cane or other article, a switch for throwing the interrupter into or out of circuit, and switches for establishing or breaking the connections between the source of current and the metallic portions.

484,626. Telephone Exchange Apparatus; John J. Mc Carty, New York. Application filed Nov. 29, 1889. A pair of loop plugs and their cords for connecting together and testing telephone lines, the strands of the cords including a loop key, the loop key having contacts with different sides of the coil of a telephonic apparatus, the coil being provided with a ground connection at its centre.



No. 484,544.—Electrical Inductorium.

484,642. Draft-Indicator for Vessels; William R. Patterson, Manistee, Mich. Application filed July 18, 1892. A draft indicator for vessels, comprising a stand pipe located within the hull of the vessel and communicating with the water outside of the hull, a float located within the stand pipe, a signal, and suitable means for operating the signal when the float shall have reached a pre-determined position in the stand pipe.

484,724. Electric Motor or Dynamo; Albert W. Smith, San Francisco, Cal. Application filed Jan. 25, 1892. In an electric motor or dynamo, in combination, a ring armature wound with a Gramme winding and two field-magnets having their respective unlike poles in close proximity, placed at diametrically opposite points of the armature, the poles alternating around the armature in the order N S N S.

484,761. Burglar Alarm; Alfred Stromberg, Chicago, Ill. Application filed July 19, 1892. In a burglar alarm protection, the combination, with flexible covering, of a circuit carried thereon, a contact making device adapted to close the circuit with the main conductor leading to the central station, and clips attached to the side of the flexible covering and adapted to move freely therewith, but to open the circuit when an attempt is made to draw the curtain aside.

484,762. Electric Bell; John E. Thron, Philadelphia, Pa. Application filed June 18, 1892. In an electric bell, the combination of a main frame, an electromagnet carried thereby, an armature pivoted thereto and operated by the electromagnet, a bell, a pivot arm carrying a hammer upon its end to strike the bell, means to move the hammer toward the bell, a stop to limit the movement of the hammer toward the bell, a pivoted pawl carried by the armature and extending up through a slot in the pivoted arm and having its end provided with a cam face, a spring to press the pawl into locking position with the pivot arm, and an adjustable part over which the car moves for the purpose of controlling the action of the pivoted trip to release the pivot arm carrying the hammer.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1836—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.